Please see

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THE BULLETIN
OF
The Institution of Engineers (India)

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MINUTES OF THE MEETING OF CORPORATE MEMBERS OF THE INSTITUTION HELD AT 8 GOKHALE ROAD, CALCUTTA 20, ON SATURDAY, 19TH OCTOBER, 1963

A Meeting of the Corporate Members of the Institution was held at the Headquarters at 8 Gokhale Road, Calcutta 20, on Saturday, 19th October, 1963, at 4.30 p.m. to consider revisions to the Bye-laws which had been proposed by the Council of the Institution, and which had been recommended by the Council to the Corporate Members at their 430th meeting held in Trivandrum on 24th and 25th August, 1963.

Dr. T. Sen, President, was in the Chair. The attendance of Corporate Members was 144.

Proceedings

The President welcomed members to the Meeting and said he would briefly relate the events which led the Council to propose revisions to the Bye-laws.

He said a new set of Bye-laws had been adopted at a Meeting of Corporate Members held in Jaipur on 26th November, 1960. At the conclusion of that Meeting, the President said, the Corporate Members had authorised the President to make drafting corrections and minor changes as were necessary in the new Bye-laws.

Thereafter, the Institution had submitted the new Bye-laws to the Government of India for approval by the appropriate authority, as it was considered unrealistic to present them to Her Majesty's Privy Council. The position of the Privy Council in respect to the Institution was not clear, and, further, Clause 18 of the Royal Charter required that any amendments to the Bye-laws had to be allowed by the Privy Council.

The Government, however, advised that after the passing of the Constitution of India there was no authority in India which could take the place of the Privy Council for the purpose of granting the consent required by the Charter for amendment of the Bye-laws. It also said that its absence did not, however, prevent the Institution from amending its Bye-laws and such amendments were valid and binding as if they had been approved by the Privy Council. Accordingly, the President said, the revised Bye-laws were adopted by the Council at their 426th meeting held on 12th August, 1962, with immediate effect.

On 10th November, 1962, however, the Institution was served with a Court injunction, on the application of two Corporate Members, by which the operation of the new Bye-laws was restrained. The matter was then moved from a lower court to the Calcutta High Court. The case was heard in due course, and the High Court delivered judgment on 24th May, 1963, to the effect that the Privy Council had no jurisdiction in India under the changed constitutional position, and that the Institution was competent to amend its Bye-laws without reference to the Privy Council.

In the meantime, the 429th meeting of the Council had been held on 22nd May, 1963. At that meeting, therefore, the judgment of the Calcutta High Court was not available. A proposal was made that the time available before the judgment was delivered could be made use of by looking into certain anomalies and inconsistencies in the new Bye-laws to which some members had often drawn attention. The new Bye-laws having been already declared operative by the Council, the President could not make any further corrections or changes although authorised by the Corporate Members at Jaipur to do so. The Council, then, at that meeting, unanimously decided to appoint a Committee to review the new Bye-laws for the purpose of removing anomalies and inconsistencies.

The Committee then set to work, and in this process, further anomalies became evident. The Committee also noticed certain important omissions. The Committee, therefore, re-drafted the Bye-laws to the best of their ability and presented them to the 430th meeting of the Council held in Trivandrum on 24th and 25th August, 1963.

The Council, at that meeting, the President continued, devoted several hours in discussing the work of review carried out by the Committee, and with some modifications, adopted the reviewed Bye-laws, and decided to recommend these Bye-laws to the Corporate Members at a General Meeting which they proposed should be held at the Headquarters on 19th October, 1963.

The President concluded that the reviewed Bye-laws were now, therefore, before the Corporate Members, and invited a member of the Council to move that they be adopted.

Shri J. Datt (*M.*) said that before he moved the Bye-laws before the Meeting for adoption, he would like to draw the attention of the Meeting to certain printing mistakes. These were the following:

In Bye-law 39, line 1, 'Associated Member' should read 'Associate Member'; in Bye-law 44 line 4, '42(i)(a) and (b)' should read '43(i)(a) and (b)'; In Bye-law 66, line 1, '42 and 43' should read '43 and 44'; in Bye-law 69, line 4, '67' should read '68'; in Bye-law 70, line 2, '42 and 43' should read '43 and 44'; in Bye-law 76(b), line 2, 'devised' should read 'demised'; in Bye-law 83(b)(i), line 2, '72' should read '73'; in Bye-law 85, line 2, '28(b) should read '83(b)' ; in Bye-law 85, in line 3, '82(b)(iii) should read '83(b)(iii)' ; in Bye-law 87, line 3, '85' should read '86'; in Bye-law 89, line 5, '85' should read '86' ; in Bye-law 89, line 5, '95' should read '96'; in Bye-law 94, line 2, the punctuation of a full stop at the end of the line should read as a comma; and in Bye-law 98(b), line 2, '93(i)' should read '94(i)'.

Shri Datt then proposed that, with these corrections, the revised Bye-laws be adopted. Maj.-Gen. S. P. Vohra (M.) seconded the proposal.

At this stage Shri Jatindra Singh (M.) said that he wished to draw the attention of the President to present Bye-law 77(1), by which he understood that a Meeting of Corporate Members for considering amendments to Bye-laws could only be called by the Council when the Council was required to do so by a requisition signed by not less than 100 Corporate Members of whom not less than 50 should be members.

The President observed that Bye-law 77(1) had also an alternative provision for calling a Meeting of Corporate Members by which such a Meeting could be called by the

Council whenever the Council decided to call such a Meeting. He then asked the Meeting to interpret which of these two readings was correct. The Meeting unanimously approved that the present Meeting was in order.

The President then said that the motion of Shri Datt (*M.*), seconded by Maj.-Gen. Vohra (*M.*), was before the Corporate Members. He said that if any of them wished to move amendments to any particular Bye-laws, he would be glad to receive them in writing. He requested that members intending to move such amendments should immediately set them down in writing and hand them over to him in ten minutes.

During the ensuing ten minutes certain members handed over written amendments to the President. At the end of that period, the President said that he would take up the amendments one by one. He also said he would like to put those Bye-laws on which no amendments were proposed to the Meeting for adoption. The Meeting unanimously approved of the President's proposal.

The President said that Shri D. M. Sen (*M.*) had proposed the following amendment to Bye-law 1: 'the words 'males' and 'females' should be replaced by the words 'men' and 'women'.

The President said that he understood that it was in legal parlance the words 'males and 'females' were generally used, and it appeared to him that no change was necessary in this regard. The Meeting unanimously agreed that no change was necessary,

The President then said that Shri Baleshwar Nath (*M.*) had proposed the addition of the words 'and Union territory' between the words 'each State' and the words 'of the Indian Union' in Bye-law 3.

The President said that this was worthy of the Meeting's consideration and asked the opinion of the Meeting. The amendment was accepted unanimously.

The President next said that Shri Baleshwar Nath (*M.*) had proposed that in Bye-law 4 the word 'geographical' should be replaced by the word 'territorial'. He said to the Meeting that the word' 'geographical' did not have a connotation referring to mountains and rivers only, but already carried a territorial sense. Shri Baleshwar Nath (*M.*) thereupon withdrew his amendment.

The President then said that Shri D. M. Sen (*M.*) had proposed that in Bye-law 5 the word 'orders' should be replaced by the word 'classes'.

Shri S. Bandopadhyaya (*M.*) asked the President's permission to explain the difference in content between the two words. He said that the word 'order' denoted a higher level of sequential arrangement and gave the example of the biological systems of classifications. 'Order' denoted a group above a 'class', and, therefore, according to him, the Bye-law as it read was correctly phrased. Shri Sen (*M.*) thereupon withdrew the amendment.

The President then said that Shri N. N. Chakrabarti (*A.M.*) had proposed that the last sentence in Bye-law 6 should be amended to read 'The Council shall be competent to make any delegation of its said powers or duties to the President or the Secretary, if circumstances so demand'. Shri S. Datta (*M.*) seconded the proposal.

The President pointed out that the first sentence of this Bye-law already stated that 'The Council shall exercise all the powers of the Institution and control, govern, do and discharge all the affairs and duties of the Institution......', and accordingly there appeared to be no need to have such an amendment. Shri Chakrabarti agreed, and withdrew the amendment.

At this stage Shri S. Datta (*M.*) said that it seemed to him more appropriate that this Bye-law which related to the management of the Institution should be carried over to just before Bye-law 45.

Shri J. Datt (*M.*) said that the Bye-law was correctly placed, as in the first few Bye-laws the main features of the constitution and administration of the Institution were briefly stated, before each of these items was further developed in the succeeding Bye-laws.

The President suggested that Bye-law 6 may remain where it was, and this was agreed to unanimously by the Meeting.

The President said that the next proposed amendment related to Bye-law 7, and this was from Shri D. M. Sen (*M.*). The proposal was to replace the words 'promoting the study' by the words 'the advancement'.

The President observed that this seemed to be an improvement, and the amendment was carried unanimously. The President then observed that as a consequence the words 'promoting the study' in Bye-law 8 should also have to be changed by 'the advancement', which was accepted unanimously.

The President said that the next amendment was from Shri N. N. Chakrabarti (*A.M.*), and this concerned Bye-law 8. Shri Chakrabarti had proposed that the following sentence should be added to this Bye-law: 'The Council may also abolish any Division if after five years from its establishment the number of Corporate Members in that Division is less than 300'. Shri S. Datta (*M.*) seconded the proposal.

After some discussion, the amendment was carried unanimously.

The President then said that Shri D. M. Sen (*M.*) had proposed the insertion of the words 'after obtaining their consent' in Bye-law 12 between the words 'by the Council' and the words 'to be Honorary Member'. He observed that this did not seem to be necessary, as obviously the high dignitaries who would be Honorary Members would not be elected by the Council without obtaining their consent. Shri Sen agreed to withdraw the amendment.

The President then said that Shri N. N. Chakrabarti (*A.M.*) had proposed the addition of the words 'or the sciences' between the words 'engineering' and 'every such election' in Bye-law 13.

Shri Chakrabarti explained that if this was done, it would eliminate the need to create a new class of members as 'Fellows' in the immediately following Bye-law 14.

Here Prof. N. S. Govinda Rao (*M.*) said that he disagreed with the proposal to remove the class of Fellows and that he would reserve his remarks till Bye-law 14 was discussed. Shri Chakrabarti's amendment was seconded by Shri S. Datta (*M.*).

After discussion, it was accepted unanimously.

The President then said that another amendment to Bye-law 13 had also been proposed, and this came from Shri D. M. Sen (*M.*). The proposal was to add the following sentence to this Bye-law : 'The Council shall frame rules for the election of such Honorary Life Members and in regard to the manner of bestowing the honour on them'.

The President said that as this provision already existed in the present Bye-laws, the amendment could be accepted. It was carried unanimously.

The President said that Shri N. N. Chakrabarti (*A.M.*) had proposed that Bye-law 14 in regard to the creation of a new class of 'Fellows' should be deleted. Shri S. Datta (*M.*) seconded the proposal.

Prof. Govinda Rao (*M.*) said he would like to explain the reasons why the Committee which reviewed the Bye-laws had recommended the creation of this class. He said that the class of 'Fellow' would be distinct from the class of 'Honorary Life Member', and it was proposed that only those who had done outstanding work in their respective branches of knowledge would be elected as 'Fellows' each year, and the scope of this class would also embrace those who had made outstanding contributions to sciences connected with the practice of engineering or outstanding services rendered to the prosecution of engineering works.

A certain amount of discussion followed, after which the President announced that he would put the amendment to vote. It was carried by 67 to 57 votes.

The President then said that as a consequence of the deletion of the class of 'Fellow', reference to this class in Bye-law 5 shall also have to be omitted. Furthermore, all the succeeding Bye-laws shall have to be re-numbered. All this was agreed to by the Meeting.

The President then said that the next amendment concerned Bye-law 15 (re-numbered 14). Shri U. N. Mahida (*M.*) had proposed that the word 'full' be deleted in (iii)(a). The President suggested that this may be accepted, and it was carried unanimously.

The President then said that Shri N. N. Chakrabarti (*A.M.*) had proposed that in Bye-law 16(ii) (re-numbered 15(ii) the words 'as exempting from Sections A and B of the Associate Membership Examination' between the words 'recognized by the Council' and the words 'or employment in engineering research' should be deleted. This was seconded by Shri S. Datta (*M.*). Shri Chakrabarti explained that the reason for proposing the amendment was that the teachers of engineering in engineering institutions conducting diploma classes should not be prevented from joining the Institution as Associate Member.

The amendment was carried unanimously.

The President then said that the Meeting could proceed to Bye-law 37 (re-numbered 36) to which Shri N. N. Chakrabarti (*A.M.*) had proposed an amendment comprising the deletion of part (a) of this Bye-law. This proposal was seconded by Shri S. Datta (*M.*). The President observed that the legal advice taken had also recommended this deletion as Honorary Life Members should not be said to enjoy all the rights and privileges of the Institution. The amendment was carried unanimously. The President then said that as a consequence parts (b), (c) and (d) shall have to be re-numbered (a), (b) and (c).

The President said that, further, in Bye-law 38 (re-numbered 37) the reference to Honorary Life Member shall have to be omitted.

The President then said that the next amendment concerned Bye-law 45 (re-numbered 44), but that he would take it up at the end.

He proceeded to Bye-law 51 (re-numbered 50), on which Shri U. N. Mahida (*M.*) wished to speak.

Shri Mahida (*M.*) said that, as after this Meeting the Secretary would not be able to notify the Honorary Secretaries of the Local Centres about the number of members of the Council who would retire at the next Annual General Meeting before the date of 31st August, some provision shall have to be made for the late conduct of elections in this year.

After discussion, the Meeting agreed that without making any amendment to the Bye-law, the following resolution should be adopted by the Meeting to enable elections to the 1963-64 Council to be conducted following this Meeting :

'*Resolved* that in the year 1963 the elections to the Council shall be proceeded with immediately after the conclusion of this Meeting, and such elections shall be held and completed by 31st December, 1963, or immediately thereafter.'

The President said that, next, Shri N. N. Chakrabarti (*A.M.*) had proposed the addition of the following words at the end of Bye-law 53 (re-numbered 52) : 'upon the recommendation of that Local Centre'. Shri S. Datta (*M.*) seconded the proposal.

It was carried unanimously.

The President said that Shri D. M. Sen (*M.*) had proposed the following revisions to Bye-law 54 (re-numbered 53) : addition of the words 'by a Division Board' between the words 'shall be carried on' and the words 'in accordance with' ; replacement of the words 'laid down' by the word 'framed'; and deletion of the words 'The Council shall have the power to vary the same as they may deem fit'.

The President said that the Bye-law seemed to read well as it was, and suggested to Shri Sen that he may withdraw these amendments. Shri Sen agreed to do so.

The President said that to Bye-law 55 (re-numbered 54) Shri D. M. Sen (*M.*) had proposed the addition of the article 'a' between the words 'attached to' and the words 'particular Division'. He said this was a printing omission which shall have to be corrected.

The President said that the next amendment concerned Bye-law 56 (renumbered 55) and had been proposed by Shri D. M. Sen (*M.*). The proposal was to replace the Bye-law entirely by the existing Bye-law 46. Here Shri J. Datt (*M.*) observed that the election of Chairmen of the Division Councils with which the present Bye-law 46 dealt had already been dealt with by the revised Bye-law 55 (re-numbered 54), and consequently Bye-law 56 (re-numbered 55) may remain as it was. This was agreed to by Shri Sen (*M.*).

The President said that Shri D. M. Sen (*M.*) had also proposed that Bye-law 57 (re-numbered 56) should be replaced by present Bye-law 49.

The President observed that the contents of the two Bye-laws were different, and consequently this did not constitute a proposal of amendment..

The President said Shri Baleshwar Nath (*M.*) had proposed the addition of the words 'and removed' between the words 'shall be appointed' and the words 'by the Council' to Bye-law 58 (re-numbered 57). The President said this was already understood and did not need specification. Shri Baleshwar Nath (*M.*) then withdrew the proposal.

The President said that Shri D. M. Sen (*M.*) had moved the following amendment to Bye-law 60 (re-numbered 59): the addition of the words 'and its Local Centres and Sub-Centres' between the words 'of the Institution' and 'shall be the State Bank of India'. The President suggested that this may be accepted, and it was carried unanimously.

The President said that the next amendment concerned Bye-law 62 (re-numbered 61). Shri D. M. Sen (*M.*) had proposed the omission of the following words 'Pending the making and approval of the Bye-laws at an Extraordinary General Meeting of Corporate Members specially called by the Council for this purpose, and', so that the sentence started thus: 'Pending the election of a Council according to the provisions of these Bye-laws........' This was seconded by Shri Baleshwar Nath (*M.*). It was carried unanimously.

The President then said that Shri D. M. Sen (*M.*) had proposed the following amendment to Bye-law 63 (re-numbered 62): the addition of the article 'a' before 'General Meeting' at the end of the Bye-law, and the addition of the words 'or an Extraordinary General Meeting' at the end of the Bye-law.

The President observed that the expression 'Corporate Members in General Meeting' was correct, and there was no need to add the article 'a'. Also, as the reference is to powers to be exercized by the Corporate Members in any General Meeting, it was not necessary to add a reference to Extraordinary General Meetings. Shri Sen (*M.*) accepted the Presidents' reading.

The President said, next, that Shri N. N. Chakrabarti (*A.M.*) had proposed the following amendment to Bye-law 77 (re-numbered 76): 'The Council shall constitute a Finance Committee and the number of members of the Committee would be such that one seat is allotted to each Local Centre who shall elect its member from among its Council members'. Shri S. Datta (*M.*) seconded the proposal. The President requested Shri Chakrabarti not to press for this amendment, as the Council had proposed the reconstitution of the Finance Committee for reasons of expedition and compactness. Shri Chakrabarti thereupon withdrew the amendment.

The President next said that Shri N. N. Chakrabarti (*A.M.*) had proposed the following amendment to Bye-law 81 (re-numbered 80): 'No payments from the moneys or funds of the Institution shall be made except under the express or implied sanction of the Council, and all cheques shall be signed by the Secretary and a member of the Finance Committee'. The President said that as now a finance officer had been appointed in the Institution, it was proper that he should be associated with the making of payments. Therefore, it would be appropriate if the cheques were signed by the Controller of Accounts and the Secretary or a member of the Finance Committee. The President's suggestion was carried unanimously.

The President said that an amendment to Bye-law 85 (re-numbered 84) was proposed by Shri N. N. Chakrabarti (*A.M.*), and this was the substitution of the word 'one hundred' by the word 'fifty' between the words 'at least' and 'Corporate Members' in line 4 of this Bye-law. This was seconded by Shri S. Datta (*M.*).

After discussion, the Meeting decided in favour of the retention of the words 'one hundred'.

The President then said that Shri N. N. Chakrabarti (*A.M.*) had also proposed an amendment to Bye-law 86 (re-numbered 85), and this was the addition of the following sentence at the end of this Bye-law: 'These provisions shall not, however, apply to Bye-law 2 which shall be operated only according to its own provisions'. Shri S. Datta (*M.*) seconded the proposal. The amendment was carried unanimously.

The President said that Shri N. N. Chakrabarti (*A.M.*) had proposed the substitution of the word 'seven' by the word 'three' between the words 'not less than' and the words 'days before the hour' in Bye-law 97 (re-numbered 96). Shri S. Datta (*M.*) seconded the proposal. The amendment was carried unanimously.

The President then said that Shri N. N. Chakrabarti (*A.M.*) had proposed the deletion of the words 'and the Secretary' between the words 'member of the Council' and the words 'shall not be accountable' in Bye-law 104 (re-numbered 103). Shri S. Datta (*M.*) seconded the proposal. The amendment was carried unanimously.

Lastly, the President said that Shri N. N. Chakrabarti (*A.M.*) had proposed the substitution of the words 'the Secretary or such other person or persons the Council may appoint for this purpose. The Secretary or such other person or persons' by the words 'the President or a member of the Council. The Secretary and the President or a member of the Council' in Bye-law 105 (re-numbered 104). This was seconded by Shri S. Datta (*M.*). The amendment was carried unanimously.

The President said that for reasons of grammer, the words 'in his presence' at the end of the Bye-law shall have to be omitted.

Finally, the President said that he would go back to Bye-law 45 (re-numbered 44). He said he had received an amendment from Shri N. N. Chakrabarti (*A.M.*) reading as follows: 'The Council shall consist of the President, the two immediate Past-

Presidents, the Chairmen of Local Centres, 30 Corporate Members who shall be elected by Corporate Members from the Local Centres, the number of seats allotted to each Local Centre being proportional to the strength of Corporate Members of that Local Centre, provided that at least one seat is reserved for each Local Centre, and two members of each Division who shall be elected by the members of the Division.' This was seconded by Shri S. Datta (*M.*).

After considerable discussion, the Meeting adopted Bye-law 45 (re-numbered 44) unanimously as presented to the Meeting.

With the permission of the Chair, Shri N. N. Chakrabarti (*A.M.*) placed the following resolutions before the Meeting :

'*Resolved* that within one year of passing of these Bye-laws the Secretary shall classify the Corporate Members according to the Divisions.

Also *Resolved* that for the elections to the Council to be conducted immediately after this Meeting, in the year 1963 only members of the Council from the Divisions shall be elected by the members of the present Council and the members of the Committees of the Local Centres.

Further *Resolved* that the Council and the Corporate Members in General Meeting consider within one year of the passing of these Bye-laws the revision of the constitution of the Council thus : 'The Council shall consist of the President, the two immediate Past-Presidents, the Chairmen of Local Centres, 30 Corporate Members who shall be elected by the Corporate Members of the Local Centres, the number of seats allotted to each Local Centre being proportional to the strength of Corporate Members of that Local Centre, provided that at least one seat is reserved for each Local Centre, and two Corporate Members from each of the Divisions who shall be elected by the members of the respective Divisions.'

These were seconded by Shri S. Datta (*M.*).

The resolutions were carried unanimously, and the Meeting decided that these would be resolutions of the Corporate Members in General Meeting and not part of the Bye-laws.

Shri U. N. Mahida (*M.*) then proposed that the Bye-laws as passed above at the Meeting be adopted with immediate effect. Shri J. Datt (*M.*) seconded the proposal. This was carried unanimously.

In conclusion, the President thanked the Corporate Members for attending the Meeting and taking so much interest in the proceedings.

With a vote of thanks to the Chair, the Meeting terminated at 7.10 p.m.

ANNUAL REPORT OF THE COUNCIL FOR 1962-63*

The Council present to members the Annual Report for the year ended August 31, 1963.

1. Membership

1.1. *Members on the Roll*

The Roll of the Institution on August 31, 1963, stood at 42,894 with members and attached persons and bodies under different grades as below:

Honorary Members	Honorary Life Members	Members	Associate Members	Companions	Graduates	Students	Affiliates	Subscribers	Total
14	3	1,664	8,378	2	1,317	31,406	12	98	42,894

1.2. *Applications*

The position of applications for membership received and considered during the year under report was as follows:

Number of applications brought forward from the year 1961-62 ..	4,264
Fresh applications received during the year ..	9,663
	13,927
Balance at the end of the year awaiting disposal ..	2,085

1.3. *Year-Book* 1961-62

The third edition of the Year-Book of the Institution, corrected to August 31, 1962, was published in January 1963.

1.4. *Obituary*

The Council regret to record the deaths of the following members during the year:

Nawab Ahsan Yar Jung Bahadur, Faridoon Sohrabji Chenoy, Anthony Cathcart Coubrough, Gavin Chapman Gordon Dobbie, Charles Auld Duncan, Susil Kumar Dutt, R. Dwarka Pershad, Philip Sydney Edward Jackson, Jagat Singh, Jawand Singh, Daya Krishna Khanna, S. H. Lakshminarasappa, Vishwanath Apparao Majumdar, Narendra Kumar Mitra, Kali Sahaya Mukherjee, R. K. Nairman, Pyare Lal Pahwa, Maj. Mohan Chandra Pande, Sir Thomas Guthrie Russell, Saileswar Sanyal, Nagendra Nath Sen, Krishnaswamy Sitaraman, Dhondo Govind Sowani, Pritam Chatomal Vasandaney, Panna Lal Verma.

Associate Members

R. Aiyakannu, Damodardas Dwarkadas Akruwala, Capt. Prem Sagar Bakshi, Raj Krishna Bhatt, Pritam Singh Bhogal, Bimal Chandra Das Gupta, Narendra Prakash Jain, Panduranga Anant Joshi, Ambika Charan Maitra, Rama Prosad Mukherjie, Channappa Ningappa Nandihalli, Gnanamuthu Meston Pancharatnam, Ram Kishore, Natwarlal Naranlal Rawal, Kanai Lal Roy, A. Sangappa, P. N. Sharma, Satya Narain Singh, Charanjiv Rai Syal.

Students

P. K. Bhaduri, N. C. Das, S. K. Kundu.

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* The Annual Report appears here in abridged form. Copies of the unabridged Report can be had on application from the Secretary.

2. Finance and Accounts

2.1. The Statement of Accounts and the Balance Sheet duly audited by the Institution's Auditors for the year ended August 31, 1963, is given in Appendix I of the Annual Report (*not included here*).

2.2. During the year under report, a number of donations were received (*details are given in the full Annual Report*).

2.3. *Public Charitable Trust for the Advancement of Engineering Education*

The following members were the Trustees of the Trust for the year: Dr. T. Sen, President, Maj.-Gen. Harkirat Singh, Dr. K. L. Rao, Shri D. P. R. Cassad and Shri S. B. Joshi, Past-Presidents.

3. The Council

During the year under report, the following ordinary Council meetings were held:

1.	New Delhi	.. November 13, 1962
2.	New Delhi	.. February 17, 1963
3.	Bangalore	.. May 22, 1963
4.	Trivandrum	.. August 24-25, 1963

4. Standing Committees of the Council

4.1. The Finance Committee of the Council consisted of the following members:

The President

Andhra Pradesh Dildar Hussain	*Madhya Pradesh* Prof. A. Lakshmanaswamy
Assam G. C. Goswami	*Madras* M. Ganapati
Bengal P. K. Ghosh	*Mysore* R. A. Rajagopal
Bihar D. Mookerjea	*Nagpur* K. S. Ramu
Bombay J. G. Bodhe	*Orissa* S. S. Behera
Delhi Maj.-Gen. S. P. Vohra	*Poona* Prof. M. V. Deshpande
Gujarat M. M. Patel	*Punjab* Jatindra Singh
Jammu & Kashmir B. N. Mengi	*Rajasthan* K. C. Satsangi
Kerala V. Ranganathan	*Uttar Pradesh* K. N. Misra

4.2. The Applications Committee of the Council consisted of the following members :

The President

Andhra Pradesh
Brig. N. Sen Gupta
C. Seshavatharam

Assam
S. P. Chaudhury
M. R. Sitaram

Bengal
B. N. Banerjee
B. N. Chaudhuri

Bihar
D. Mookerjea
G. S. Purohit

Bombay
R. N. Joshi
N. N. Purandare

Madras
Prof. P. Rajagopal Pillai
Prof. A. Srinivasan

Mysore
B. V. Patankar
C. N. Sharma Rao

Nagpur
H. G. Chaoji
K. S. Ramu

Orissa
P. M. Menon
A. Shankaran

Delhi
Dr. Shiv Narayan
Maj.-Gen. S. P. Vohra

Gujarat
G. S. Desai
M. M. Patel

Jammu & Kashmir
S. N. Toshakhani
V. D. Zadoo

Kerala
S. Ramachandra
S. Varadaraja Sarma

Madhya Pradesh
Maj. L. R. Baronia
M. Y. Koli

Poona
G. T. Gokhale
Dr. N. S. Nandeeswaraiya

Punjab
R. N. Chona
G. C. Khanna

Rajasthan
K. N. Bhargava
T. M. Desai

Uttar Pradesh
B. D. Goyal
S. P. Sinha

4.3. The Examinations Committee of the Council consisted of the following members : The President, Sarvashri K. C. Banerjee, Dildar Husain and V. G. Garde, Prof. N. S. Govinda Rao and Brig. P. R. Kumar.

4.4. *Engineering Research Committee*

The Committee consisted of the following members :

Prof. N. S. Govinda Rao (*Convenor*), Dr. A. K. Chatterjee, Dr. M. N. Dastur, Prof. M. V. Deshpande, Dr. V. M. Dokras, T. R. Gupta, R. N. Joshi, R. S. Mehta, V. Y. Kamat, S. Varadaraja Sarma, Lt.-Gen. Sir Harold Williams, S. R. Mehra, S. Swaymbu, Maj.-Gen. S. P. Vohra, E. A. Nadirshah, Dr. K. L. Rao, K. F. Antia and B. R. Subramanyam (*Secretary*).

One meeting of the Committee was held. The subjects discussed included the quick training of personnel for engineering research, publication of monographs on specialized subjects, establishment of development institutes for creating new indigenous designs, institution of courses in specialized fields, expansion of library facilities at the Local Centres, role of Indian consulting engineers, and other matters.

4.5. *Engineering Education Committee*

The Committee consisted of the following members :

Prof. M. V. Deshpande (*Convenor*), Dr. A. K. Chatterjee, Dr. M. N. Dastur, Dr. V. M. Dokras, Prof. N. S. Govinda Rao, T. R. Gupta, R. N. Joshi, R. S. Mehta, S. S. Kumar, N. N. Purandare, Prof. H. N. Ramachandra Rao, Prof. N. N. Sen Gupta, K. C. Banerjee, J. Datt, T. A. Desai and B. R. Subramanyam (*Secretary*).

One meeting of the Committee was held. Among the subjects discussed were the need for reform in the present system of examinations, closer liaison between the universities and industry, training of young engineers, the retention of English as the medium of instruction, and publication of cheaper editions of engineering text-books. Appropriate recommendations were also made to the various educational authorities in the country.

4.6. *Flood Control Committee*

The Committee consisted of the following members :

Dildar Husain (*Convenor*), P. R. Ahuja, R. D. Dhir, Prof. N. S. Govinda Rao, P. R. Guha, C. L. Handa, D. V. Joglekar, B. P. Kapadia, G. A. Narasimha Rao, S. Varadaraja Sarma, C. Seshavatharam and Dr. H. L. Uppal.

4.7. *Power Supply Management and Organisation Committee*

The Committee consisted of the following members :

P. K. Ghosh (*Convenor*), N. K. De Sirkar, Prof. M. V. Deshpande, V. Y. Kamat, H. S. Kulkarni, K. S. Ramu, Prof. A. Srinivasan and S. Mukhopadhyay (*Secretary*).

5. **Revision of Bye-Laws**

The revised Bye-laws which were passed by a Special Meeting of Corporate Members at Jaipur on November 26, 1960, had been brought into force by the Council at their 426th meeting held in Calcutta on August 12, 1962. This action was taken after advice was received from the Ministry of Scientific Research and Cultural Affairs, Government of India, saying that the Ministry of Law concurred with the opinion previously expressed by the Attorney-General of India that after the passing of the Constitution of India there was no authority in India which could take the place of the Privy Council for the purpose of granting the approval required by the Royal Charter for amendment of the Bye-laws of the Institution, and that such did not prevent the Institution from amending its Bye-laws, and amendments in accordance with its own rules were valid and binding as if they had been approved by the Privy Council.

On 10th November, 1962, the Institution was served with a Court injunction, on the application of two Corporate Members, by which the operation of the new Bye-laws was suspended. Elections to the Council which had just been previosly commenced were also, as a consequence, suspended.

The case was heard by the High Court, Calcutta. The judgment was delivered on 24th May, 1963, by which it was held that the Institution was competent to amend its Bye-laws without reference to the Privy Council.

This was considered by the Council at their 430th meeting held in Trivandrum on 24th and 25th August, 1963. The Council also, at the same time, discussed the work of a Committee which they had appointed at their 429th meeting held in Bangalore on 22nd May, 1963, to review the new Bye-laws. At the 430th meeting, the Council decided to make certain further revisions to the new Bye-laws and adopted these revisions at the meeting. The Council also called a General Meeting of Corporate Members to consider these revisions on 19th October, 1963, at Calcutta.

6. **Sub-Centre**

During the year, a new Sub-Centre was established at Neyveli.

7. **The *Journal* and the *Bulletin***

7.1. *The year's publications*

The publications policy of the Institution was revised in June 1961, and as a result, the *Journal* was divided into seven Parts corresponding to the Divisions of the Institution. These were: Civil Engineering Division; Mechanical Engineering Division; Electrical Engineering Division; Electronics and Telecommunication Engineering Division; Chemical Engineering Division; Mining and Metallurgy Division; and General Engineering Division. During the course of the year, a Public Health Engineering Division was created and the corresponding publication formed the eighth Part of the *Journal*. The *Journal* Parts were regularly issued under this scheme during the year.

The *Bulletin* was published each month as heretofore.

7.2. *Technical Papers*

The number of technical papers and articles published under the various Divisions and Groups in the *Journal* during the year were: Civil Engineering Division 21, Mechanical Engineering Division 24, Electrical Engineering Division 24, Electronics and Telecommunication Engineering Division 11, Chemical Engineering Division 5, Mining and Metallurgy Division 1, General Engineering Division 12, Public Health Engineering Division 3, Structures Group 1—Prestressed Concrete 3, Structures Group 2—Shell Structures 7, Roads and Road Transportation Group 2, Railway Engineering Group 1, Industrial Engineering Group 2, Nuclear Engineering Group 2; and in the *Bulletin*, 9 articles were published in the same period, making a total of 127. Besides these, 3 articles on Contemporary World Projects and 2 discussions on papers were also published.

The number of papers received during the year was 234. Out of these, 128 were approved for publication, and 39 were awaiting the recommendations of the Divisional Chairmen.

7.3. *Hindi Section*

The Hindi Section continued to be guided by Shri Brijmohan Lal, Adviser. Under the new scheme of publications, its *Journal* was issued in January 1963, April

1963 and August 1963. The first issue contained 7 articles, the second 6 articles and the third 6, making a total of 19.

The publication of the Hindi Section *Journal* as a separate volume has appreciably improved the standard of the articles.

7.4. *Museum of Indigenous Technical Literature*

More books have been added to the Museum during the year. The Museum is under the charge of the Nagpur Centre and works under the guidance of Shri Brijmohan Lal, Adviser, Hindi Section.

8. **Examinations**

8.1. *Results of examinations held in November* 1962 *and May* 1963

The results of the Institution examinations held in November 1962 and May 1963 were as follows :

Studentship Examination

		November 1962	May 1963
No. of candidates appeared	..	819	881
No of candidates passed	..	89	79
Percentage passed	..	10.86	8.96

Section A (*Old Scheme*)

		November 1962	May 1963
No. of candidates appeared	..	6,553	6,413
No. of candidates passed	..	524	590
Percentage passed	..	7.99	9.26

Section A (*New Scheme*)

		November 1962	May 1963
No. of candidates appeared	..	515	1,339
No. of candidates passed	..	Nil	6
Percentage passed	..	Nil	0.44

Section B (*Old Scheme*)

		November 1962	May 1963
No. of candidates appeared	..	1,635	1,651
No. of candidates passed	..	305	508
Percentage passed	..	18.65	30.76

Section B (*New Scheme*)

		November 1962	May 1963
No. of candidates appeared	..	53	139
No. of candidates passed	..	3	10
Percentage passed	..	5.66	7.19

Section C

No. of candidates appeared ..	13
No. of candidates passed ..	11
Percentage passed ..	84.61

9. Recognition of Exempting Qualifications

(a) The following qualifications were recognised as exempting from the Studentship Examination of the Institution :

(1) Overseer Certificate in Civil Engineering of the Gandhidham Polytechnic, Adipur, Kutch.

(2) Diplomas in (i) Agricultural Engineering, (ii) Cinematography and Sound Engineering, (iii) Mining Engineering, and (iv) Telecommunication Engineering of the State Board of Technical Education and Training, Madras.

(3) Diploma in Mining Engineering of the State Board of Technical Education and Training, Andhra Pradesh.

(4) Diploma in Civil, Mechanical and Electrical Engineering of the State Council of Technical Education and Training, Orissa.

(5) Bachelor of Science Degree Examination with Mathematics, Physics and Chemistry.

(6) Final Examination of Railway Mechanical and Electrical Apprentice Class of the System Technical School, Central Railway, Jhansi.

(7) (i) Electrical Artificers 5th Class—(a) Power, (b) Radio, (c) Air (Power) and (d) Air (Radio), (ii) Electrical Mechanicians 4th Class, courses conducted at I.N.S. 'Valsura', Jamnagar, and (iii) Engine Room Artificers 5th Class, conducted at I.N.S. 'Shivaji', Lonavla.

(b) The following qualifications were recognised as exempting from Sections A and B of the Associate Membership Examination of the Institution :

(1) B.E. Degrees in (i) Civil, (ii) Mechanical, and (iii) Electrical Engineering of the University of Jodhpur.

(2) B.Tech. Degree in Chemical Engineering of the Andhra University.

(3) B.C.E. Degree in Civil Engineering of the Jadavpur University.

(4) B.Tel.E. Degree in Telecommunication Engineering of Jadavpur University.

(5) B.E. Degree in Mining Engineering of Rajasthan University up to 1962.

(6) B.E. Degree in Mining Engineering of Jodhpur University.

(7) (i) Electrical Specialisation Course, and (ii) Ex-Upperyardmen—Sub/Lt. (L) Professional Course, conducted at I.N.S. 'Valsura', Jamnagar.

(8) (i) Basic Engineering Course for 'E' & 'L' Officers, (ii) Direct Entry Engineer Officers Professioal Course, and (iii) Ex-Upperyardmen-Sub/Lt. (E) Professional Course, conducted at I.N.S. 'Shivaji', Naval College of Engineering, Lonavla.

(9) B.E. Degree in Telecommunication Engineering of the Roorkee University.

10. Annual General Meeting

The 43rd Annual General Meeting was held in Bangalore between May 18-22, 1963.

A full account of the 43rd Annual Convention was published on pages 12-52 of the Bulletin, vol. 12, no. 11, July 1963.

11. Representation on other bodies

The names of the representatives of the Institution on other bodies are given in Appendix II of the Annual Report (*not included here*).

12. International Conferences

Sixth Plenary Meeting of the World Power Conference, Melbourne, Australia, October 20-26, 1962.

The Sixth Plenary Meeting of the World Power Conference was held in Melbourne, Australia, between October 20-26, 1962. The theme of the Meeting was 'The Changing Pattern of Power'.

The Institution in its capacity as the Indian National Committee for the World Power Conference submitted the following papers for the Meeting :

(1) 'Hydro-electric Resources of India' by K. P. S. Nair (*M.*)

(2) 'Progress of A.C. 25 kV Single-Phase Electric Traction in India' by H. D. Awasty (*Non-member*)

(3) 'Some Economic Aspects of Nuclear Power in India' by Dr. H. J. Bhabha (*Hon. M.*) and M. Dayal (*Non-member*)

(4) 'Coordination of Different Types of Electrical Power Stations' by Prof. M. V. Deshpande (*M.*)

The delegation from the Indian National Committee consisted of the following : Prof. M. V. Deshpande (*M.*) (Leader), Chairman, Electrical Engineering Division, Shri S. Swayambu (*M.*) and Shri M. Dayal (*Non-member*).

Sixth World Petroleum Congress, Frankfurt, German Federal Republic, June 19-26, 1963.

The Sixth World Petroleum Congress was held in Frankfurt, German Federal Republic, between June 19-26, 1963.

The Institution in its capacity as the Indian National Committee for the World Petroleum Congress submitted the following paper : 'Exploration and Development for Oil in India' by L. P. Mathur (*Non-member*), and G. Kohli (*Non-member*), of the Oil and Natural Gas Commission, Government of India.

The delegation from the Indian National Committee consisted of the following: Dr. J. W. Whitaker (*M.*), Maj.-Gen. R. A. Loomba (*M.*) and Shri R. D. Varma (*M.*).

At the 430th meeting of the Council held in Trivandrum on August 24-25, 1963, a request received from the Ministry of Mines and Fuel, Government of India, that the functions of the Indian National Committee may be handed over by the Institution to the Oil and Natural Gas Commission was considered. The Council agreed with this proposal, and decided that the work of the Committee should be transferred to the Oil and Natural Gas Commission. Steps are being taken to effect this transfer.

Fifth Commonwealth Engineering Conference, Canada, September 9-21, 1962

The Fifth Commonwealth Conference of the Engineering Institutions of the British Commonwealth was held in Canada from September 9 to 21, 1962. The Conference was attended by the President, Maj.-Gen. Harkirat Singh (*M.*), and the Secretary, Shri B. Seshadri (*M.*).

13. Paper Meetings at Local Centres, Visits and Excursions

Details are given in Appendix III of the full Annual Report.

14. The Council wish to thank the many honorary workers for their very valuable service rendered during the year and to record that they are deeply conscious of their contribution. In particular, the Standing Committees of the Council, the Committees of the Local Centres, and Shri Brijmohan Lal, Adviser, Hindi Section, deserve mention. The Council also acknowledge with appreciation the great volume of work conducted by the staff of the Headquarters, Local Centre and Sub-Centre offices.

Summaries of Papers Published in the Journal, Vol. 44, no. 2, pts. EL 1, CH 1 and PH 1, October 1963

ELECTRICAL ENGINEERING DIVISION

Electronic Analogue Computer as an Aid in the Analysis of Electrical Machines

Dr. R. E. Bedford
Associate Member

and

S. K. Mukerji
Non-member

In this paper is presented an analogue computer set-up for investigating the linear and non-linear integro-differential equations of performance of a two-axis commutator machine.

Thermal Circuit Analysis of Unconditioned Buildings

C. L. Gupta
Non-member
and
B. C. Raychaudhuri
Non-member

This paper outlines the principles of circuit analysis for predicting the thermal behaviour of unconditioned buildings exposed to tropical climates. The essential assumptions involved are detailed. Nottage technique is utilized to solve the thermal circuit representation of a room having four exposed surfaces. It has been adapted to quick manual computation using a desk calculator by considering only two harmonics and taking two lumps. The accuracy of prediction under these restrictions on the technique is brought out by graphs giving a comparison between computed values and experimental data obtained in a full scale test house. The order of accuracy obtained and the simplicity of approach permit this analysis to be a reliable application technique for similar thermal problems.

A D.C. Negative Resistance Circuit and Its Use in Electrical Analogues

P. V. Indiresan
Non-member

A transistorized D.C. negative resistance circuit which can be used in the solution of differential equations of complex systems by the method of the electrical network analogue is described. The examples of a laterally loaded strut and the flow of heat through the walls of buildings have been given to explain how negative resistances can be used to analyze practical problems.

Model Tests for Grounding Systems

T. Nookiah Chetty
Non-member
and
H. N. Ramachandra Rao
Member

Grounding electrode voltage gradients present a potential hazard to both animal and human life. Danger arises from both step and touch voltages. It is essential to design a grounding arrangement so that both step and touch voltages are kept within safe limits. Various factors such as length, depth of burial, spacing, geometry and configuration of electrodes influence potential gradients. Analytical methods to investigate the effect of these various factors are difficult. Model tests offer a convenient means for comprehensive investigation. Tests have been conducted on reduced scale models of grounding systems in an electrolytic tank to investigate the effect of the various factors on potential gradients. The main conclusion of this paper is that the configuration of earth electrodes has a significant influence on potential distri-

bution and hence by choosing a suitable configuration, hazards arising from potential gradients can be eliminated.

Analogue Methods in Electromagnetic Field Problems

Dr. V. Subbarao

Associate Member

All engineering problems can be broadly grouped into two types which can be termed as 'lumped' and 'distributed' systems. The common electric networks consisting of resistance, inductance and capacitance can be represented by definite magnitudes of their individual values, and hence, they are lumped systems. In all lumped systems, the physical dimensions and location have no direct consequence on the system. There are a set of problems in which the interest centres not on the element considered as a whole but at every point or segment. For example, the behaviour of a spring as a whole attached to a load comes under the lumped case, whereas the behaviour of every point in the spring is vastly different from the earlier case. Every point has to be taken into consideration depending on its position and location. Such type of problems where the individual location and position of every point plays its part are called 'problems of distributed parameters' or more commonly, as 'field problems'. A number of authors have done extensive experimental work using various types of analogues and some of them are suggested in the references given in the paper.

CHEMICAL ENGINEERING DIVISION

Heat Recovery from Sulphate Black Liquor Solids

H. P. Didwania

Graduate

In view of our insufficiency in fuels and the rising prices of fuels, the pulp and paper industry in India is at present facing a crisis. Difficulties in getting adequate railway wagons for supply of coal, etc. to the factory site from coal mines limit the location of the future units exclusively very near to mines. Further, with the partial exhaustion of some of the coal mines, coal of good quality and grade is not available to consumers, thus affecting the working and efficiency of steam generation plants. The purpose of this paper is to discuss the theory, practice and plant design of recovery units in sulphate mills and report studies and conclusions on the operating procedures that will enable to overcome some of the handicaps incurred by having to use coal as the main fuel.

Trend in the Utilization of Coal Resources in India for Thermal Generation of Electricity

S. B. Sarkar

Associate Member

The Third Five Year Plan has been formulated to secure a rise in national income by plus 5% per annum, to be made possible with the expansion of basic industries like fuel, power, chemicals, machine buildings, etc. and increase in agricultural production. It is estimated that demand of coal for the power houses at the end of the Third Plan (1965-66) will be nearly 20 million tons. A target has been set for achieving production of 97 million tons of coal at the end of the Third Plan period. More than 20% of total raisings of coal will be utilized for thermal generation of electricity by the public utility power houses in the country. As the demand of power houses will be mainly for coal in slack size, a disparity is bound to arise in the demand and availability of slack coal in the corresponding grades. From the projected and existing washeries, about 4 million tons of middling is expected to be surplus annually and may be used in making up the shortfall in the raising of coal at any time in the applicable grades. Wherever slack coal can be utilized whether for combustion such as for power generation and brick-burning or for process requirement such as manufacture of cement, town gas, etc., its compulsory use had to be introduced. The overall quality, however, will be governed by the general principles laid down by the Fuel Efficiency Committee, Government of India, on the requirement of power generation, and as far as load demand and distribution characteristics permit, large coal-based thermal power stations will have to be designed for pulverized fuel firing.

PUBLIC HEALTH ENGINEERING DIVISION

Accelerated or High Rate Sludge Digestion

S. R. Kshirsagar

Associate Member

Sludge digestion is an important process carried out at almost all the sewage treatment plants. Modern experimental research and pilot plant scale studies have shown that this process can be accelerated by proper conditioning of the sludges to be treated and their mixing with the digester contents, and by skilful and vigilant operation. Thus, their loading can be easily doubled by using the 'accelerated or high rate' system. This can result in great economy in the overall cost of the treatment works. It is suggested that Indian engineers should try to adopt this system in the design of new schemes.

Lactose Assimilation in Sewage Micro-Organisms

T. Shivaji Rao

Non-member

and

K. Krishnamacharyulu

Associate Member

This paper states some of the basic principles involved in the method of formulating a procedure for a short-term biochemical oxygen demand test, in determining the ultimate B.O.D., the maximum solids production, the maximum rate of oxygen uptake and the minimum and maximum requirements of oxygen for biological degradation of a soluble substrate. Based upon two concepts, *viz.*, concepts of 'assimilation' and

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'plateau', the study was undertaken to evaluate the total oxygen demand test which involves the measurement of the B.O.D. value at plateau in oxygen utilization and the resulting cell-growth there. The paper gives an insight into oxidative-assimilation relationships in the soluble substrate, *i.e.*, lactose, and the method used consisted of recording the oxygen uptake values at very short intervals, using the standard dilution technique.

INSTITUTION NOTICES

Composition Fees

The rates of composition fees for Members were revised and approved by the Council with effect from **1st September, 1963.** The revised table is given below.

Age next birthday, years	Revised rate, Rs.
36	934
37	917
38	897
39	876
40	857
41	832
42	809
43	780
44	753
45	725
46	693
47	657
48	620
49	582
50	540
51	497
52	449
53	399
54	345
55	284

Note : Members who have attained the age of 55 years or over and have retired from active duty may compound their future annual subscriptions at the revised rate of Rs. 250.

Associate Membership Examinations

The Council at their 430th meeting held in Trivandrum on 24th and 25th August, 1963, resolved that the last date for holding the examinations under the old scheme be extended for a further year, *i.e.*, till November 1965.

Additional List of Referees for Students appearing in Section B of the Associate Membership Examination

The following is an additional list of referees to that which appeared in the *Bulletin* dated October 1962 and May 1963.

Andhra Pradesh Centre

135. M 2080 K. Kondayya ((M)
Retired Superintending Engineer, 47-10-8 Dwarakanagar, Visakhapatnam 4.

Bengal Centre

105. AM 11018 A. Bhattacharya (M)
68/2-C Purnadas Road, Calcutta 29.

106. AM 7568 Kalharan Chakravarti (E)
28/3-C Shanagar Road, Calcutta 26.

107. AM 5872 P. C. Chandra (M)
67, Nimu Gossain Lane, Ahiritola, Calcutta 5.

108. AM 8270 N. N. Chopra (C)
Zonal Engineer, Chief Engineers Office, Durgapur Steel Project, P.O. Durgapur 3, District Burdwan.

109. M 2584 Arunprasad Ghosh (M)
Principal, K. G. Engineering Institute, P.O. Bishnupur, Bankura, West Bengal.

110. AM 7410 Sailendra Narayan Ghosh (M)
Lecturer, Kanchrapara Technical School, Eastern Railway, P.O. Kanchrapara, 24 Parganas, West Bengal.

111. AM 7708 Amalendu Ghoshal (M)
81A Satish Mukherjee Road, Calcutta 26.

112. AM 7272 Ajit Kumar Hazra (M)
104 South Sinthee Road, Calcutta 30, West Bengal.

113. AM 7196 Raghunath Sahai Jain (C)
A.P.W. Circle, Port Blair, Andaman.

114. M 2246 Prasanta Kumar Mandal (M, E)
9 Indian Mirror Street, Calcutta 13.

115. AM 8235 Asrujit Mukherjee (M)
16 Sardar Sankar Road, Calcutta 26.

116. AM 8987 B. K. Mukherjee (E)
13 Pratapaditya Place, Ground Floor, Calcutta 26.

117. AM 9861 N. N. Roy (E)
251/A/6A Netaji Subhas Chandra Bose Road, Naktala, Calcutta 40.

Bihar Centre

34. AM 8365 S. K. Sharma (M, E)
Electrical Executive Engineer, Bihar State Electricity Board, Patna.

35. AM 8894 S. S. Thakur (M)
Executive Engineer (Mechanical), The Indian Oil Refineries Limited, P.O. Hathidah, Patna, Bihar.

Kerala Centre

33. AM 2773 M. P. Mathew (M)
Professor of Mechanical Engineering, College of Engineering, Trivandrum.

Madhya Pradesh Centre

47. AM 10123 M. M. Gupta (E)
11 Kirodimal Colony, Raigarh, Madhya Pradesh.

Mysore Centre

33. AM 11125 T. S. Krishnamachar (E)
14521 5th Cross, Krishnamurthy Puram, Mysore 4.

34. AM 7920 H. K. Rajaram (C)
Executive Engineer, Long Range Water Supply Scheme, P.W.D. Bangalore.

35. AM 6869 C. Srinivasan (C)
50 S. N. Iyengar Street, Seshadripuram, Bangalore 12.

36. AM 11084 A. Veerabhadrappa (E)
Lecturer in Electrical Engineering, University College of Engineering, Bangalore.

Poona Centre

45. AM 7605 D. S. Dravid (M, E)
Deputy Engineer, Regional Workshop Sub-division Dapuri, Poona 3.

46. AM 10383 G. K. Rao (M)
Armament Research & Development Establishment, Kirkee, Poona 3.

Punjab Centre

22. M 2636 Bal Kishen (E)
Superintending Engineer, Patiala Circle, Punjab State Electricity Board, Patiala, Punjab.

23. AM 10276 P. P. Singh Basur (C)
Executive Engineer, Provincial Division, Public Works Department, B & R, 'Winterfield', Simla 3, Punjab.

24. AM 5820 Lt. Col. Gurbaksh Singh Brar (C)
Engineer, Commander Works Engineers, Ferozepore Cantonment, Punjab.

25. AM 4545 K. L. Kapoor (C)
Executive Engineer, Jullundur Provincial Division, Jullundur Cantonment, Punjab.

26. AM 9612 Om Parkash Kapur (C)
Executive Engineer, Rohtak Construction Division, P.W.D. B & R., Rohtak.

27. AM 4619 H. C. Malhotra (C)
Superintending Engineer, P.W.D. B & R Branch, Patiala, Punjab.

28. AM 8781 Ram Ditta Mal Malik (C)
Executive Engineer, Power House Designs, Officers Hostel, Nangal Township, District Hoshiarpur, Punjab.

29. AM 7537 Kuldip Singh Pram (C)
8F-26/II-C Sector, Chandigarh, Punjab.

30. M 2490 Dr. Harbans Lal Uppal (C)
Director, Irrigation & Power Research Institute, Amritsar, Punjab.

Rajasthan Centre

22. AM 7577 Prof. R. D. Singh (MM)
Head of the Mining Department, Faculty of Engineering, University of Jodhpur, Jodhpur.

Misdemeanour in the Institution Examinations

The Council have decided to cancel the results of the following candidate for the November 1962 examinations and debar him from appearing in the two immediately following examinations, *i.e.*, up to and including November 1963, for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 28877	1651 A	Gopinath Guin

The Council have decided to cancel the results of the following candidate for the May 1963 examinations and debar him from appearing in the November 1963 examinations for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 23135	6054 A	Pirthipal Singh

The Council also decided to cancel the results of the following candidates for the May 1963 examinations and debar them from appearing in the two immediately following examinations, *i.e.*, up to and including May 1964, for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 38368	3537 A	Pawan Kumar Gupta
S 20326	458 B	Mridul Baran Dutta

Sale of Question Papers of the Institution Examinations

The Institution has appointed Messrs. Naba Mudran, Ltd., 170A Acharya Prafulla Chandra Road, Calcutta 4, as sole agents for the reprinting and selling of question papers of the Studentship and Sections A and B of the Associate Membership Examinations with effect from November 1963. Students and intending buyers should contact them directly and remit money to them *only*. Further details will be given in a future issue of the *Bulletin*. This notice is for the advance information of Students and intending buyers.

The Association of Consulting Engineers (India)

Sponsored by the Institution, the Association of Consulting Engineers (India) was registered on 16th January, 1960 under Section 25 of the Indian Companies Act 1956 with its headquarters in New Delhi. It was inaugurated by Prof. Humayun Kabir, Union Minister, Scientific Research and Cultural Affairs on 4th February, 1960, in the presence of a distinguished gathering in New Delhi.

The main objects of the Association are to promote the advancement of the profession of Consulting Engineers, give Government, the public and other organizations facilities for conferring on engineering matters, promote efficiency and just and honourable dealings in engineering practice, encourage inventions and investigations and make known their nature and merits, etc.

Membership is open principally to such Corporate Members of the Institution who have ten years good standing to their credit, and who are working as Consulting Engineers, individually or in collaboration with others, and have no financial interest in the manufacture or sale of goods or in contacting business as partners or shareholders.

The admission fee is Rs. 200 and the annual subscription is Rs. 50.00.

Members eligible for admission and joining the Association are requested to write to Shri T. R. Mehandru, Honorary Secretary, 14 Asaf Ali Road, New Delhi. Meetings of the Association are hereafter proposed to be held in different parts of the country on different occasions.

Proposed Symposium on 'Concrete Construction' at the 44th Annual Convention, Hyderabad, February 1964

A Symposium on 'Concrete Construction' will be held during the 44th Annual Convention to be held in Hyderabad in February 1964. A list of titles is given below to indicate the scope of the symposium. It is intended to cover all aspects of concrete construction excluding the design aspects of concrete structures. Members can write papers on any one or more of the subjects listed or any other allied subjects.

A. *Plain concrete*

1. Basic materials like cement and aggregates
2. Admixtures
3. Methods of mix design
4. Formwork
5. Machinery for making concrete in large quantities
6. Methods of compaction of concrete
7. Influence of temperature variations
8. Creep and shrinkage in mass concrete
9. Special concretes like prepakt, vacuum, light weight, heavy weight, fire-proof, sound-proof, etc.
10. Methods of curing concrete
11. Concreting under water
12. Research on concrete construction methods

B. *Reinforced concrete work*

1. Uses of different types and shapes of steel
2. Use of vibrators in heavily reinforced structures
3. Precast constructions
4. Joints, hingers and rockers
5. Pumped concrete

6. Construction of tall structures like chimneys, cooling towers, etc.
7. Construction of tunnel linings

C. *Prestressed concrete*

1. Different types of high tensile steel in prestressed work
2. Different forms of anchorages and relative merits based on their performance in structures already built
3. Continuity in prestressed concrete work
4. Composite constructions involving prestressed concrete
5. Loss of prestress and verification with the performance of structures built,
6. Cracking of prestressed concrete structures, particularly at the anchorage zone.

D. *Description of structures constructed and/or in construction in India*

Abstracts of papers may be sent to Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, Professor of Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12, before **December 15, 1963**, and the complete papers with necessary illustrations in original before **December 31, 1963.**

Proposed Symposium on 'Small Scale Industries,' Hyderabad, February 1964

At the 430th Meeting of the Council held in Trivandrum during August 24-25, 1963, Prof. N. S. Govinda Rao (*M.*), Chairman, Engineering Research Committee, proposed to hold a Symposium on 'Small Scale Industries' on the basis of a note prepared by Shri V. Y. Kamat (*M.*), a member of the Committee. The Council resolved that the Symposium be held during the 44th Annual Convention. The note prepared by Shri Kamat is given below and papers are invited from members on any of the points suggested therein by December 31, 1963.

The part the Institution as a body can play to assist industries to research

1. *Relationship between major industries and small industries to manufacture components required for the major industries*

Even though during the recent years small scale industries have made considerable progress, their growth has been haphazard and rather uncoordinated with the development of large scale industries sector. Consequently, small scale industries have found it very difficult to get all materials and facilities like power, transport and communications and skilled and technical personnel They have also found it very difficult to market their products profitably and have encountered financial difficulties in respect of their growth. All these developments have highlighted the importance of a distinct policy for small scale industries whereby they could be developed as ancillaries to big industries.

It would be therefore advantageous to evolve in India such a pattern of industrialization as would encourage the growth of small industries, producing components and spare parts required by big industries, around such big industries. In highly developed countries like the U.S.A., U.K. and Germany, large industries depend on small scale ancillary units for nearly 60% of their components. During recent years owing to the paucity of foreign exchange allocations, big industries have not been able to import components and spare parts in adequate quantities and consequently have to sustain great losses due to the under-utilization of their capacity. Big industrial units would not be able to manufacture economically the required different types of components and spare-parts the production of which needs a special care, skill and specialized knowledge. If, however, they establish independent small scale industries or encourage such industries to manufacture the components and spare-parts required by them, they would be able to take advantage of their specialization and obtain components and spare parts covering a very wide field. They would be also able to concentrate on the production of their products in the final form and thereby achieve substantial gains. By becoming ancillaries to larger units, small scale units can derive certain advantages particularly in respect of marketing of products, improvements in the quantity and quality of products, and getting technical know-how and advice from larger units. It is necessary to bear in mind that they are able to derive these advantages without losing their identity and independence. The small scale industries due to the specialized nature of their work and small size would be economical and efficient in the production of components and spare parts required by the big industries.

It is, however, necessary to take certain precautions in order to ensure that such a pattern of industrial development is able to achieve the desired objectives in the best possible way. It would be advantageous for big industries to educate the small-scale manufacturers and also to help them by all the possible means particularly by solving their technical difficulties. In case of non-standardized components it would be necessary to enforce quality control techniques and carryout periodical inspections. Big industries will have also to take the necessary steps like creation of buffer stock for ensuring that they are able to get the components and spare parts in time. In other words, the small-scale industries should be organized in such a way as would enable the big industries to secure in time the components of required quality.

It is indeed a matter of great pleasure that the Central Government and State Governments are also taking certain steps in this direction. The Government of India have established Development Councils for fostering the growth of certain industries including small scale units as ancillary to large units. State Governments have proposed to establish three functional industrial estates in connection with automobile ancillaries, radio electronic and electrical instruments and light engineering during the Third Plan. These industrial estates would give scope for the development of small-scale industrial units as ancillary to large scale units.

2. *The desirability of allocating a particular area, a district, a city or a taluk, say, for a particular industry at one central place*

Concentraion of certain industries in a certain area having certain locational advantages, is advantageous from certain points of view. For instance, it would be advantageous to concentrate cotton textile industry in an area which has, apart from the other locational advantages, a wet climate. Similarly a country mineral deposits with concentrated mineral deposits in a particular area, would advantageously concentrate its metallurgical industries in such an area. Though the natural advantages would help the concentration of industries in a particular area, the concentration would enable these industries to derive subsequently various other advantages. These industries by mutual cooperation can pursue various activities of common interest and thereby reduce their costs and increase their profits. They can, for instance, collectively purchase raw materials, sell their finished products, organize training centres for their labourers and produce other products by using their by-products. Concentration of the industries in a particular area also attracts various other industries producing their raw materials and consuming their products and by-products as raw materials. Concentration of industries, thus, accelerates the nation's industrial growth and also its industrial mutation.

However, it may not be possible for all the types of industries to secure all the advantages of location like availability of power, water, raw materials, etc., at one place. It would not be possible for certain industries like sugar industry or paper industry, which, due to the bulky nature of their raw materials, have a tendency to concentrate in the areas producing their raw materials. Moreover, the present policy of the Government is to encourage the dispersal of industries throughout the country and to encourage the economic development of under-developed areas. The problem of localization of industries has, therefore, ceased to be purely an economic problem and has become a problem inolving various political and sociological considerations.

3. *The optimum size of units for industries whether we should have a few big ones or a number of small ones to manufacture basic requirements like iron and steel, aluminium, etc.*

An optimum size of an industrial unit can be determined after taking into consideration its optimum size from the technological considerations, optimum size of its administrative department, its optimum financial growth, optimum size of its marketing department and the elements of risks and hazards involved. Small scale industries are suitable for carrying out such activities as they do not involve use of plants and machineries of large size and of complicated nature and requiring enormous capital investment. Iron and steel and aluminium industries have to use big plants and machineries for enjoying the advantages of large scale production and therefore they need large capital investment. The units must, therefore, be very big in size in order that they are of an optimum size. Large size of such units is advantageous to them in various respects. They are thereby able to make the maximum possible use of the modern technique and employ specialized tehnicians. They can market their products successfully by developing their marketing section and carrying out effective advertising. Large units enjoy financial stability and can, therefore, easily attract funds in the form of capital and loan from the society.

4. *Power requirements—the best combinations of small Diesel power units, steam power units and hydro-electric units for best economic development of the country*

Geography and geology play a very important role in the supply of power and determining its cost. In India it would be possible to generate power on a large scale from various sources like water-fall, oil, coal, lignites, uranium, thorium and natural and refinery gases. It has been estimated that India has potentiality of extracting as much as 50,000 million tons of coal bulk of which lies mainly in Bihar and western part of West Bengal. Oil refineries have been established at Cambay, Bombay, Vishakapatnam, Baraumi, Digboi and Gauhati. During the Third Plan it has been proposed to use for the generation of power the natural gas, which has been found at Nahorkatia. As regards hydro-electric potential in India, it has been estimated that it would be about 41 million kWH. Recently nuclear power programme has been chalked out for using thorium and uranium for generating electricity. Such generation of power would need large investment and skilled personnel and sufficient time-lag.

While planning the method of power generation in a particular area, it is necessary to consider the cost of production, total capital required, foreign exchange requirements and the time required for the establishment of the project. Nuclear stations would need more foreign exchange than coal power stations and coal power stations would need more foreign exchange than hydro stations. Establishment of large thermal stations employing higher steam temperatures and pressure would reduce the cost of production and capital cost. In areas like Bihar where coal is available in large quantity, it would be advantageous to use thermal power and coal. Similarly, the plains in U.P. have economic advantages in using coal and thermal power. But hilly places like Western Maharashtra far away from the coal producing areas and capable of producing hydro electric power can use the same advantageously for reducing their cost.

It has been estimated that the cost of generation of electricity for hydro, coal, and atomic power stations would be 1.2 nP., 3 nP. and 3.5 nP. per kWh respectively. Hydro electric power is very cheap to produce as compared to thermal power but hydro electric power has to be usually moved over long distances unlike the thermal power. The areas far away from coal producing centres and unable to produce or get hydro-electric power would be compelled to use Diesel oil though it is relatively more costly.

5. *Research necessary for substituting raw materials available in the country in place of those that are now being imported from abroad in manufacturing process*

One of the conspicuous features of our industrialization has been the existence of certain gaps in our industrial structure inspite of fairly rapid industrialization during the recent years. The production of certain items has been extremely slow and certain items are not being manufactured at all. Consequently our country has to import every year vital raw materials and spare parts and components exceeding Rs. 100 crores in value. It is urgently necessary to suggest methods of carrying out industrial surveys and preliminary studies of industries, enjoying high priority in the Third Plan with a view to finding out the gaps in our industrial structure. This would easily reveal certain specific investment opportunities and also the possibilities of substituting raw material components available in the country in place of those that are being imported from abroad. There is also great scope for improving the quality of certain raw material components which are available in India, and having after improvement, the potentiality of replacing those imported from abroad. Apart from these studies and researches, it is necessary to carry out a systematic geological survey of India.

6. *Training of craftsmen in industries at all levels*

It has been estimated that about 1.3 million craftsmen would be required in engineering and non-engineering activities during the Third Five Year Plan. With a view to attain the target certain industrial training institutes have been started by some private parties as well as by some Government Departments like Labour and Employment, Commerce and Industry, Defence, Posts and Telegraphs and Railways. The

Ministry of Labour and Employment has increased the training centres from 59 by the end of the First Plan to 167 by the end of the Second Plan and thereby increased the number of seats for the candidates from 10,500 to 42,000. In the Third Five Year Plan, 318 training centres have been visualized which would provide training facilities to about 58,000 craftsmen. Seats of employed industrial workers attending evening classes have been proposed to be increased from 2,000 to 11,000. The Railways, the Defence Department and other Government Departments, have also proposed to increase their facilities of technical training. Moreover, the Small Scale Industries Service Institutes would be expanded sufficiently enough to meet the requirements of skilled personnel of the small-scale industries. Apart from these, there would be training facilities under National Apprentice Scheme for about 12,000 candidates and the apprentice scheme would be implemented on a compulsory basis.

It would be advantageous for a big industrial unit to provide training facilities to its craftsmen at all levels for increasing their skill and making them specialized in their specific jobs because such training is not usually available elsewhere and there are great variations in the requirements of various industries regarding the skill. Such a programme of educating the craftsmen, if well organized and prepared would be advantageous to the industrial unit in the long run because it would ensure a smooth supply of skilled workers and foster their sense of loyalty to the organisation by giving them an opportunity to prosper in the organization. Small-scale industries would not be able to provide such training and, therefore, they should evolve a group system of training for meeting the requirements of skilled craftsmen.

INSTITUTION NEWS

Dr. T. Sen re-elected President for 1963-64

Dr. T. Sen (*M.*) has been unanimously re-elected by the Council as President of the Institution for the year 1963-64. This is the fifth time in the history of the Institution that a President has been re-elected to office. Shri N. V. Modak was President for 1940-41 and 1941-42, Dr. A. N. Khosla for 1948-49 and 1949-50, Dr. K. L. Rao for 1958-59 and 1959-60, and Maj.-Gen. Harkirat Singh for 1960-61 and 1961-62.

Dr. Sen is the Rector of the Jadavpur University. A brief life-sketch of Dr. Sen was given in the *Bulletin* dated December 1962.

Action taken on Resolutions passed at 43rd Annual General Meeting, Bangalore, May 1963

The following action was taken on various Resolutions adopted by the General Body of Corporate Members at the Closing Session of the 43rd Annual General Meeting held in Bangalore on 21st May, 1963 :

Public Health Engineering Division

Resolution 2: '*Resolved* that the Public Health Engineering Division notes with deep concern that the specialized branch of Public Health Engineering has been left out from the All-India Service of Engineers. It feels strongly that this would come in the way of attracting in sufficient numbers of bright and capable engineers to this important field of engineering. It strongly recommends that the Institution take up the matter with the Government of India and get this important branch put in line with other branches, *viz.*, Buildings, Roads, Irrigation, etc.'

A letter was addressed by the Secretary to the Secretary to the Government of India, Ministry of Home Affairs, on 14th June, 1963. The letter was acknowledged by the Under-Secretary to that Ministry in a letter dated 24th June, 1963.

Resolution 4: 'Resolved that the Public Health Engineering Division expresses its keen interest in the International Conference on Water Pollution Research to be held in Tokyo in August 1964 and lends its wholehearted support by sponsoring this Conference on behalf of the Institution of Engineers (India), together with Central Public Health Engineering Research Institute. It also commends to the Central Public Health Engineering Organization of the Ministry of Health to join in this sponsorship. It requests the members to send papers to the Steering Committee at the earliest and their active interest and participation in this Conference in view of the serious problems of water conservation and stream pollution facing India.'

A letter was addressed by the Secretary to the Secretary to the Government of India, Ministry of Health, on 14th June, 1963. It was acknowledged by the Director-General of Health Services in a letter dated 30th July, 1963, saying that the matter was receiving attention.

Resolution 6: 'The Public Health Engineering Division strongly recommends to the Ministry of Health to restart the convening of yearly State Public Health Engineering Conferences where all-India problems of public health engineering can be discussed and tackled most expeditiously'.

A letter was addressed by the Secretary to the Secretary to the Government of India, Ministry of Health, on 14th June, 1963. It was acknowledged by the Director-General of Health Services in a letter dated 30th July, 1963, saying that the matter was receiving attention.

Students Session

Resolution 2: '*Resolved* that to organize the activities of Students Chapters the Council be requested to be more liberal in the allocation of grants up to a maximum of Rs. 1,000 for any Local Centre having two or more Students Chapters, as and when the activities warrant'.

The above resolution was placed before the Finance Committee at their 426th Meeting held on 23rd August, 1963. The Finance Committee accepted the proposal and recommended it to the Council. The Council at their 430th Meeting held on 24th and 25th August, 1963, approved of the recommendation, and the necessary budget provision has been made for 1963-64.

Resolution 3: '*Resolved* that for Students securing exemptions in at least one paper of the Section A or the Section B examination under the old scheme of examinations by November 1963, the Examinations Committee and the Council be requested to extend the time limit for the old scheme now set at November 1964 for completing the Section by a further year'.

The above resolution was placed before the Examinations Committee at their 63rd Meeting held on 15th and 16th July, 1963. The Examinations Committee accepted the proposal and recommended it to the Council. The Council approved of the recommendation at their 430th Meeting held on 24th and 25th August 1963, and extended the last date for the old scheme of examinations by a further year, that is, till November 1965.

Resolution 4: '*Resolved* that the Institution should take up the matter of recognition of the passing of Sections A and B of the Associate Membership Examination as equivalent to the passing of the engineering degree examination with the Government of Maharashtra and other State Governments where such recognition has not so far been granted'.

The recognition of the passing of Sections A and B of the Associate Membership Examination of the Institution as equivalent to the passing of an engineering degree examination is being pursued with a number of State Governments, mainly through the respective Local Centres.

Reception to Dr. T. Sen

A reception was given to Dr. T. Sen on his election as President of the Institution for 1962-63 by the Bengal Centre on June 22, 1963. About 300 members attended the function which was held at the Sir R. N. Mookerjee Hall. Shri S. Bandopadhyaya, Chairman, Bengal Centre, delivered the welcome speech which was later replied to by Dr. Sen.

Welcome Address by Shri S. Bandopadhyaya, Chairman, Bengal Centre

We have assembled here today to express our joy and a sense of the private honour in Dr. Triguna Sen being elected the President of the Institution I have been thinking about this. Why, when somebody we know, when somebody we love, when somebody we cherish, attains any importance in life, it gives us some added joy, some particular sense of vicarious enjoyment wherein we feel that we share the honour, the duties, the ability and the *sadhana* of the person who has attained that eminence. Let us take a particular occasion as this. I was thinking whether it is a biological and basic parochial idea we have in ourselves. That fundamental animal in man which likes to cherish its own dear ones—be they parents, be they children, be they any relative, like that. Is it something primaeval like that by which somebody would know and cherish and work with and be together, if such a person by his ability, by his good fortune, by his *sadhana*, attains a position which we not only covet, but which we honour and respect. I have come to the conclusion that it is not so. I have come to the conclusion that in our sojourn in this life irrespective of what we do, irrespective of what we achieve, we have always not only nurtured but also gathered in our minds an attachment for that transcendental quality which combines all men of all times, of all ages, of all climates, of all vocations, and of all periods. Herein is a synthesis in human evolution which completely transcendents space, time and even evolution itself. Often we have occasion to think, we have occasion to deliberate, not in the purposes of our daily life but in the purposes of the eternal life wherein we are all in the same brotherhood of man. Then we find that in cherishing ideals we cherish ideates. It is not possible to cherish any ideals without thinking of a concomitant and conglomerate ideate. I give you today an ideate in Dr. Triguna Sen. We all of us hold our ideals, try to cherish our ideals, try to nurture our ideals, and at the same time we try to live the life we have to live. Here is a man whom I have known for years and years. I think I can claim to know him fairly intimately. It is true that I am guilty of holding him not only in great esteem but also in great love. Love, as you all know, is not a very rational process, and if you love somebody you feel beyond your rationality about the person you love. I plead guilty to that feeling. I tell you again that I have known Dr. Triguna Sen for years and years. I have worked with him also for years and years. And I can tell you this that I have found in him a man who in all the difficulties and turmoils and ramifications of the modern social process has been steadfast in his life's work. Here is a man who has maintained an ideal, who has believed in

Shri S. Bandopadhyaya, Chairman, Bengal Centre, Garlanding Dr. T. Sen an ideal, and who has not destroyed his ideal. In that I hold him in great esteem. It is not my purpose to say that the Institution may benefit greatly by his becoming the President. It is not my purpose to say that he belongs to Bengal and the Bengal Centre may accrue some advantages in his being the President. It is not for me to say that there are many people who would benefit because he has become the President. I am not considering those points at all. I am only considering the point that here is a man whom I have held in my thought, whom I have considered worthy of being held in my thought and in that process of thinking I am extremely happy to see that even in this pragmatic world such a person succeeds. Here material success has yielded itself to moral and spiritual wellbeing. I rejoice in that success. I am honoured in being able to share the success and I hope that all of us who are here would enjoy that success not as a physical thing but as a process which will lead them all into a life which becomes greater and greater because it envelopes everything. We all have to do all sorts of things in life. Quite a large amount of our work is fairly unpleasant. We know that. But in spite of that we all know that we have the heritage of humanity. I think here is a man who holds that heritage. I conclude by stating that about Dr. Triguna Sen I can say 'here is a man'.

SHRI BANDOPADHYAYA DELIVERING THE WELCOME SPEECH

Reply by Dr. Sen

I am grateful to you for the honour that you have shown me today. Your Chairman has been very kind to me; more kind perhaps than I deserve. As a philosopher, as a *vedantic*, as a litterateur, as an orator, he has said so much about me, and I wish I possess those qualities which he has referred to. I am indeed happy to be amidst you here, At the same time, I feel sad when I see the picture of the Late Rai Bahadur N. K. Mitra and I am sorry that he is no more. I feel I have personally lost a friend and the Institution has lost a well-wisher.

I confess I will not be able to tell you much, particularly in the flowery way in which your Chairman has spoken. Perhaps, it is for the first time, I am not sure, that the Institution has elected as its President a person from that sector of the profession which is most criticized, I mean the teaching sector. When all of you were students, you may have criticized the teachers as being harsh to you, and as those who tried to get you plucked in examinations. Now when you have become grown-up men holding responsible positions, you may also look down upon us, the teachers, saying, 'Oh, these theoretical dreamers, they have not taught us what we actually require in practice.' So we were criticized when you were students and we are criticized when you are men in positions, and I belong to that unfortunate sector of the profession. Friends, I live and work only because I have faith in man. I have faith in our students—the youth of the country. When you were students I loved you as students, I love students also now.

Dr. Sen Replying to the Welcome Address

By becoming the President of the Institution, though for a few months, I know I will not be able to achieve much, but I wish you to introduce a few programmes which will knit in closer relationship the two sectors—the teachers in the teaching institutions and the engineers in the profession. With this end in view, I have already written to the Chairmen of all the Local Centres, requesting them to see that I can start these programmes as soon as possible. I now like to explain to you the four ideas that I am trying to pursue.

Firstly, I feel that the requirements for professional recognition as set out by the Institution are characterized by a legal and static approach and do not take account of the necessity of keeping in touch with the current developments and maintaining the proficiency of each member at the highest level during his career. This static view which held good in the 19th century when the professional careers had just started and the process of technological change was very slow is to my mind outmoded. I have therefore requested the Local Centres to conduct refresher courses or at least seminars in different subjects every year.

Coming to the second idea I want to pursue, you will agree with me that only a well-informed man can be a well-informed engineer, and this will not come about unless we take deliberate steps within our educational provisions to make it so. By educational provision I do not mean merely our teaching institutions. I include also the domain of engineering employment. Too often, I feel, we regard these two spheres as separate and distinct and not as component parts of a single continuous educational process. This is why I feel that the senior members of our institution should deliberately and systematically seek their way to teach newcomers what they have themselves learnt in the sphere of engineering practice. This will be a real contribution to the formation of the next generation of professional engineers. I urge you all to take up this act as a part of your professional responsibility. I feel that the Institution should give better incentive to this aspect of engineering education, and maintain and develop a belief, a conviction, that in the last resort it is the sense of responsibility, the initiative and the inspiration of the individual which will count.

Considering the third point I like to cover, we have 31,000 Students on the roll of the Institution. All that is being done now is just to conduct examinations for them, with about 5 to 10% of them passing the same. These unfortunate students, who have not been able to go for higher education, have to work hard in factories, but each of them has naturally an ambition to become an engineer. I took this matter up with the Ministry of Scientific Research and Cultural Affairs, Government of India, and they have agreed to facilitate conduct of evening courses and have issued a circular to this effect. Following this, I have written to all Local Centres requesting them to contact the engineering colleges and polytechnics falling within the area of the Centre and start evening courses for these boys. As men in profession, you gentlemen, must come forward to and spare a few hours in the evening teach the students to make them engineers. I have been assured by the Ministry that it will meet all the expenses for this purpose. So I desire to see before the year is out that each Local Centre starts at least two such courses in the engineering colleges or in the polytechnics in that Centre.

Fortunately, I propose, and I hope you will bear with me, to set apart at least Rs. 1,00,000 to start a 'book bank'. I will just explain how I propose to do it. I have addressed the Local Centres to approach one or two engineering colleges, and obtain a list of books which are required by the boys. If a college proposes to purchase books worth Rs. 3,000, the Institution will pay Rs. 6,000 and with this amount of Rs. 9,000, the college can purchase books and one or two almirahs for keeping them, bearing the mark 'The Institution of Engineers (India)'. Each book will be issued as the Institution of Engineers (India) contribution and the students, who would become members of the Institution later, will know even from their first year in the college that here is an Institution which is helping them. In this way, starting from one to two engineering colleges in each Local Centre, I hope that in the years to come, we will be able to equip such book banks in almost all the engineering institutions in the country. This will afford a permanent book-shelf wherefrom boys can get books. The present day students cannot afford to purchase books because of their prohibitive costs. As such, they get notes from their teachers and get them by-heart, the habit of reading being thereby lost entirely. The fundamental idea of the book bank is therefore to see that the Institution helps the young men in the country to be the future engineers.

Lastly, I feel that it is the duty of a professional body to speak out what is needed for public good in the field in which its expert knowledge is applied, and to point out what is going amiss in that domain. In my view at least, so far, the Institution has been far too reluctant to let its views to be known on questions of this kind. It has, of course, been unwilling to get involved in questions which are thought to be political, but the big issues of economic prosperity and industrial vitality are not really political and there is none better qualified to give public guidance on broad technological questions without fear than this great professional institution. If we can pursue the four points I have explained, I hope I will have done something for the Institution as your President. I am indeed grateful to you for the honour you have done me this evening.'

FORTHCOMING CONFERENCES

Symposium on 'Interconnected Power System Operation in the Eastern Zone', Calcutta, December 1963

Further to the announcement published in the *Bulletin* dated August-September 1963, the following topics are proposed for presentation of papers at the symposium:

(i) Legislation pertaining to establishment of zonal grid in Eastern India;
(ii) Load forecasting technique relating to zonal grid;
(iii) Planning zonal system for integrated operation and organization pattern for zonal grid;
(iv) Business arrangement for integrated operation of zonal grid;
(v) Planning of H.V. interconnected network;
(vi) Interconnection and coordination of hydel and thermal power station;
(vii) System control and load despatch; and
(viii) Protection, communication and telemetering.

Further details can be obtained from the Honorary Secretary, Bengal Centre, The Institution of Engineers (India), 8 Gokhale Road, Calcutta 20.

Conference on 'Achievement of Self-Sufficiency in Electronics', Pilani, December 9-10, 1963

A two-day conference on 'Achievement of Self-Sufficiency in Electronics' will be held on December 9 and 10, 1963, at the Central Electronics Engineering Research

Institute, Pilani, Rajasthan. This Conference of the representatives of industry, user departments and the research institutions, will provide a common forum for discussing the problems of achieving self-sufficiency in electronic equipments. It is tentatively planned to hold sessions on the following topics :

(i) Fixation of objectives and priorities ;

(ii) Relative roles of foreign collaboration and indigenous development ; and

(iii) An integrated national effort towards self-sufficiency.

Further details can be obtained from the Director, Central Electronics Engineering Research Institute, Pilani, Rajasthan.

Symposium on 'Utilization of Metallurgical Wastes', Jamshedpur, February 1964

With a view to focus attention on multitude aspects of recovery of byproducts and metallurgical wastes, the National Metallurgical Laboratory will hold a Symposium on 'Utilization of Metallurgical Wastes' in February 1964. Under the tempo of the successive Five Year Plans, primary ferrous and non-ferrous metallurgical industries and secondary processing plants are being progressively set up in India. However, adequate attention towards effective utilization of metallurgical byproducts and wastes has not been paid so far. It is thus necessary to focus attention on the utilization of metallurgical wastes particularly under Indian conditions and processing facilities. The metallurgists, engineers, research workers, industrialists, consumers and planners will get together, exchange technical knowhow, examine inter-related problems and discuss the effective utilization of metallurgical wastes along scientific and economic lines.

The scope of the symposium will cover the following :

(i) Treatment of fines and other low grade byproduct materials produced during mining and mineral beneficiation plants ;

(ii) Utilization of byproducts and wastes produced in pyro-, hydro and other extractive metallurgical, smelting and refining operations ;

(iii) Utilization of waste gases and flue dusts produced during roasting, smelting and refining and economics of recovery operations ;

(iv) Utilization of metallic scraps, drosses, ashes and skimmings, swarfs and residues resulting during ferrous and non-ferrous metallurgical refining and processing operations ;

(v) Utilization of spent pickle-liquors and recovery of metallic values from waste solutions ; and

(vi) Theoretical considerations of recovery of byproducts and utilization of metallurgical wastes.

Further details can be obtained from the Director, National Metallurgical Laboratory, Jamshedpur 7.

Symposium on 'Productivity in Research', London, December 11-12, 1963

The Institution of Chemical Engineers, London, will organize a Symposium on 'Productivity in Research' from December 11 to 12, 1963, as a contribution to the National Productivity Year of the United Kingdom. The programme is concerned not so much with the use of research results in industry as with the selection and organization of research from the point of view of those who direct it, and it is anticipated that the programme will be of interest to scientists and engineers engaged in research or development work in a wide range of industries. The symposium will be held in three sessions, *viz.*, (i) Policy of Higher Industrial Management, (ii) Organization and Interaction in Research Success, and (iii) Effect of Environment.

Further details of the Symposium may be had from the Institution of Chemical Engineers, 16 Belgrave Square, London, S.W. 1.

Joint Conference on 'Impact of Users' Needs on the Design of Data Processing Systems', Edinburgh, March 31-April 3, 1964

The British Computer Society, The British Institution of Radio Engineers, and The Institution of Electrical Engineers will hold a Joint Computer Conference on 'Impact of Users' Needs on the Design of Data Processing Systems' in Edinburgh from March 31 to April 3, 1964, under the auspices of the British Conference on Automation and Computation.

The purpose of the Conference is to present papers and to provide opportunity for discussion on the interrelation between users, programmers and engineers in their common aim of providing efficient data processing systems. In particular, the conference will deal with some of the following topics :

(i) Input and output ;
(ii) The inter-action between compilers and the system design ;
(iii) Engineering problems of various types and levels of large stores ;
(iv) Monitoring needs and their implementation ; and
(v) Maintenance of large scale data processing systems.

The Organizing Committee invites submission of short contributions, not exceeding 1,500 words, on topics falling within the scope of the Conference.

Authors who propose to offer contributions are invited to send synopses of approximately 200 words and suggested titles for their contributions to the Conference Secretariat as soon as possible. Contributions based on accepted synopses should be submitted by December 31, 1963. Formal papers based on such contributions may also be submitted for consideration for publication in the *Proceedings of the Conference*. Copies of all the material included in the conference programme will be circulated in advance of the conference to all those who register to attend.

Further details can be had from The Computer Conference Secretariat, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

BOOK ACKNOWLEDGMENT

1. **Bridges of Calcutta and Its Surroundings.** S. Chatterjee. *The Technical Journals of India Private Ltd.*, Calcutta, Rs. 4. 67 pages.

The author has advocated the case for a second Howrah bridge and its location has been explained, based on the results and study of traffic data collected by the Howrah Improvement Trust. The chapters on 'Classification of Bridges' familiarizes the non-technical man with the types of bridges, and this is followed by the chapter 'Major Bridges of Calcutta, and Its Surroundings'. This is successively followed by description of bridges across the Circular Canal, Tolly's Nullah and within lake area, the Port area and across the Boat Canal and the railway bridges. This branch of engineering has been dealt briefly in a non-technical way in this book.

2. *Proceedings of the Seminar on Shell Structures, Oxford Book Co.*, Calcutta, Rs. 10.

This publication contains the papers read at a seminar on 'Shell Structures', held at the Bengal Engineering College, Sibpur, The papers presented cover the following topics: (i) review of developments in shell structures, (ii) theory of shell structures, (iii) design of different types of shell structures, and (iv) a review of research in shell structures conducted at the Bengal Engineering College laboratories.

3. **Traffic Engineering Practice.** Edited by E. Davies. *E. & F. N. Spon Ltd.*, London, 75s. p. 325.

Descriptive matter on the various types of traffic survey and the methods of conducting them, the more specialized studies necessary for the practical application of traffic engineering methods to the geometrical design of roads and the management of traffic flow; the end value of such studies in the designing of road improvements and intersections and of traffic regulation, and for the prediction of future traffic volume, is dealt in the first few chapters. Traffic control, principles that need to be accepted for effective street lighting, etc., are dealt with subsequently. A chapter is devoted to the principles governing the control of parking. Detailed descriptive information on instruments available to assist in the measurements required in connection with the traffic studies included is mainly meant for traffic engineers engaged in practical work.

4. **Convective Mass Transfer.** D. B. Spalding. *Edward Arnold (Publishers) Ltd.*, London, 70s. 448 pages.

This book is meant for engineering undergraduates and practical engineers who have to deal with mass transfer problems. Provided in this book is a simple and general method for calculating the rates of mass transfer processes arising in aeronautical, chemical, combustion and mechanical engineering. Typical processes for which formulae are derived include absorption, extraction, vaporization, condensation, transpiration cooling, heterogeneous catalysis, solid-fuel combustion, liquid fuel combustion, absorption with chemical reaction. The water-air system, important in airconditioning and drying practice, is dealt with in detail. Although an elementary knowledge of thermodynamics and heat transfer is required to grasp the subject matter, no advanced mathematical techniques are used in the book.

5. **Modern Power Station Practice.** vol. 1, 1963, £3, 196 pages ; vol. 2, 1963, £3, 286 pages. *Central Electricity Generating Board*, Bankside House, London S.E. 1.

This is the first volume of a five-volume series on 'Modern Power Station Practice', published by the Central Electricity Generating Board, U.K., and is intended to improve the effectiveness of the practising engineers in the electricity supply industries. It incorporates the recent developments and tries to cover the fields of future developments. This volume treats the following aspects of the subject : (i) silting of power stations ; (ii) outline design, (iii) civil works, (iv) main plant layout, and (v) electrical plant layout.

The second volume deals with such aspects practice of modern power station practice, as the boiler unit ; fuel and ash handling plant ; instrumentation ; and boiler control and operation. The various aspects of modern trends in boiler and its associated plants have been dealt in such a manner as to be of help to the practising engineers in the electricity supply industries.

7. **Problems in Electronics with Solutions.** F. A. Benson. *E. & F. N. Spon Ltd.*, London, 42s. 265 pages.

This book presents a comprehensive set of problems with their solutions, covering many significant topics in the field of electronics. This new edition has given a treatment of semiconductor devices (transistors) fully in parallel with that of devices employing valves. It will be found helpful to the students following a course on electronics.

CORRIGENDUM

TO VOL. 12, NO. 10, JUNE 1963

Page 25, under Book Acknowledgments, instead of : '**1. Irrigation Engineering.** S. R. Sahasrabudhe. *Katson Publishing House, Lucknow*. Rs. 12.50. 458 pages' please read '**1. Irrigation Engineering.** S. R. Sahasrabudhe. *Katson Publishing House, Ludhiana*. Rs. 12.50. 458 pages.'

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from Bulletin for May 1963)

STUDENTS

No.	Name
39921	Deddigamabally Sitharam Jagannathan
39922	Cpl. Hari Chand
39923	Ac. Eknath Sadashiv Chopdekar
39924	Cpl. Ramesh Chandra Thapliyel
39925	Harendra Kumar Chowdhary
39926	Shivshankar Maltare
39927	Sivagnanam Nadarajah
39928	Goverdhan Lal
39929	Parkash Chander Manchanda
39930	Narindar Kumar Jagpal
39931	Balkrishna Ramkrishnarao Datar
39932	Kishin Saney
39933	Praveen Singh
39934	Raj Karan
39935	Satya Pal Kalra
39936	Jang Bahadur Singh
39937	Amrit Lal Soni
39938	Kizhakkumpuram Parmeswaranpillai Unnikrishnan Nair
39939	Shri Chand
39940	Mahendra Kumar Surana
39941	Krishan Lal Pathria
39942	Kapal Dev
39943	Jasbir Singh Bindra
39944	Karta Krishan Mehta
39945	Ishwar Chand Menchanda
39946	Prem Paul Gupta
39947	Jamnadas Haridas Bhanani
39948	Lac. Mahabir Prasad Khandelwal •
39949	Krishna Kumar Agarwal
39950	Nakul Sain
39951	Suresh Chand Mittal
39952	Subhash Chandar Johar
39953	Kuldip Singh
39954	Satnam Singh
39955	Girdhari Lal Sroa
39956	Shivaji Subrao Sadupatil
39957	Sudarshan Kumar
39958	Dipak Kumar Mukherjee
39959	Som Datt Basson
39960	Hans Raj Rohan
39961	Anand Swarup Bhatnagar

No.	Name
39962	Kailash Narayan Gaur
39963	Ravindra Nath
39964	Biswanath Sen Gupta
39965	Bhagwandas Dahyabhai Khatri
39966	Abdul Majeed Qureshi
39967	Shyam Sunder Agnihotri
39968	Udham Singh
39969	Shrinivas Sharma
39970	Somnath Kundu
39971	Inderjit Thapar
39972	Surinder Singh
39973	Bhavaneshwar Dutta Thakore
39974	Gurmel Singh Matharu
39975	Bal Kishan Borana
39976	Tarlok Singh Rehensi
39977	Madan Gopal Alagh
39978	G. Ramalingam
39979	Jitendra Kumar Bhagat
39980	Jagdish Chander
39981	Rattan Kumar
39982	Sishu Paul Sharma
39983	Om Prakash Bohra
39984	Shardha Nand Bansal
39985	Devinder Singh Bhatia
39986	Polisetti Veera Venkata Satyanarayana Murty
39987	Mohammed Ajaz Ali Khan
39988	Katuri Gouri Sankara Hanumantha Rao
39989	Shyam Sunder
39990	Pyboina Suryarao
39991	Satya Pal Arya
39992	Cpl. Moizuddin Khan
39993	Shyam Sunder Arora
39994	Ganga Dhar Varma
39995	Kalidindi Venkateswara Raju
39996	Addepalli Murali Krishna Sastry
39997	G. Balkishan Rathi
39998	Ashraf Mahboobur Rahman Hassan
39999	Vinod Kumar Gupta
40000	Brij Kishore Mangal
40001	Hari Singh Yadav
40002	Jagdish Kumar Arora

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No.	Name
40003	Bhim Sen Chopra
40004	Madan Mohan Gupta
40005	Thomas Abraham
40006	Raghbir Singh
40007	Jaswant Raj Jain
40008	Suraj Malik
40009	Cpl. Hebbaka Ramanna Lakshminarayana
40010	Jai Pal Sharma
40011	Satya Paul Chawla
40012	Pillutla Satchidananda Thilak
40013	Gian Chand
40014	Bonam Dorayya
40015	Shyam Behari Lall
40016	Kanwar Krishan
40017	Devender Kumar Jain
40018	Goduru Venkateswara Rao
40019	Ghanta Dhruvudu
40020	Surjit Singh Syan
40021	Diwakar Kathale
40022	Narayan Rajaram Joshi
40023	Gopinath Banerjee
40024	Gian Chand
40025	Santosh Chandra Bhattacharyya
40026	Vadapalli Satyanarayana
40027	Laka Krishna Murty
40028	Vinod Kumar Bhatnagar
40029	Kusumanchi Satyanarayana Murty
40030	Sher Singh Pupneja
40031	Puran Chand
40032	Sudershan Kumar
40033	Vijay Kumar Soni
40034	Raj Pal
40035	Lokeshwar Kumar Bhalla
40036	Rameshwar Dayal
40037	Ratnakar Shridharpant Patil
40038	Man Singh Rajput
40039	Radheyshyam Bookchandani
40040	Sukh Dev Arora
40041	Shanti Prashad Bohra
40042	Suri Venkateswarlu
40043	Umesh Kumar Jha
40044	Prithvi Singh Kambal
40045	Bhagwan Sujan Singani
40046	Radha Krishna Sakalle
40047	Jai Kishan Goel

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40048	Bawa Harjit Singh
40049	Tirlok Singh
40050	G. Rajkumar
40051	Cpl. Karati Nagaraj Purushotham Naidu
40052	Rewashanker Chaudhary
40053	Narendra Kumar Jain
40054	Nandkishor Jijotiya
40055	Girdhar Lal Agrawal
40056	Ryali Satyanarayana Rao
40057	Annapurapu Vijaya Saradhi
40058	Raghavender Rao
40059	Cheeti Damodhar Rao
40060	Ghulam Quader
40061	Mohammed Farooq
40062	Jagdish Prasad
40063	Shiv Prasad Vijay
40064	Parasharam Sidu More
40065	Suresh Kumar
40066	Odanavar Gurusiddappa
40067	Aiyashastri Srinivasan.
40068	Lac. Varadarajan Ramani
40069	Prey Mohan Bhasin
40070	Phool Singh Sachan
40071	Banwari Lal Devgun
40072	Mahesh Chandra Tayal
40073	Suresh Dhondopant Joglekar
40074	Kewal Chandra
40075	Naresh Kumar Garg
40076	Cpl. Conjeevaram Ethirajmudaliar Ranganathan
40077	Murli Lal S. Mathur
40078	Ram Bharosay
40079	Arasanipalai Venkatachari Rajagopalan
40080	Mohan Behari Lall
40081	Chandra Prakash Dixit
40082	Piara Singh
40083	Gopalakrishnaiyer Ramamurthy
40084	Prem Singh
40085	Ram Lal Nangia
40086	Jayaramaiyer Subramanian
40087	Hanuman Prasad Pande
40088	Hari Saran
40089	Ashoke Kumar Nandi
40090	Balwant Singh
40091	Sudhakar Balkrishna Kale

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40093	Gurcharan Singh
40094	Man Mohan Sharma
40095	Rameshchandra Kanchanlal Talati
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40097	Ramesh Kumar Bajpai
40098	Zillur Rehaman Usmani
40099	Surendra Prasad Tiwari
40100	Jagdish Prasad Goel
40101	Iqbal Chand
40102	Kapil Deo Rai
40103	Madan Pal Pundir
40104	S. Damodara Kurup
40105	Sat Pal Chhiber
40106	Jagdish Chander Chadha
40107	Samarendra Kumar Bhattacharjee
40108	Pola Padmanabhan
40109	Jai Kumar
40110	K. Ravi Babu
40111	Sambhuchandra Dasgupta
40112	Mahendra Singh
40113	Satish Chandra Kohli
40114	Rewatram Dewandas Batra
40115	Kanwal Moohaming Ram Singhani
40116	M. Chidanandaswamy
40117	Man Mohan Bir Singh Talwar
40118	Vasant Mahadeo Thakar
40119	Vijay Kumar Gupta
40120	Gunnu Lal
40121	Gopal Das Hingorani
40122	Vijay Bharadwaj
40123	Ramesh Chander
40124	Suresh Narain Agarwal
40125	Krishan Lal Nagpal
40126	Surendra Narain Agarwal
40127	Arjan Bablani
40128	Noor Ahmed Khan
40129	Chandra Kumar
40130	Keshavapillai Narendran Nair
40131	Ravindra Kumar Saxena
40132	Raghunath Singh Tomar
40133	Bhanudas Dattatraya Kakade
40134	Devendra Nath Saxena
40135	Motilal Chhaganlal Agarwal
40136	Dilip Kumar Bhattacharjee
40137	Bakshi Ramji
40138	Ashok Ramchandra Kasturey
40139	Paul Nepo Diaz
40140	Anupan Kumar Jagota
40141	Arjan Singh
40142	Raghunath Balwant Limaye
40143	Baldev Raj Popli
40144	Parikshit Charan Roykarmakar
40145	Bhailal Vanmalidas Poojara
40146	Romesh Chand
40147	Vijay Pal
40148	Ruldu Ram Ubby
40149	Kishor Yashwant Rao Shinde
40150	Ram Naresh Shukla
40151	Wasant Digamber Khanwalkar
40152	Raja Bhoj Puri
40153	Kamalakar Padmakar Javkhedkar
40154	Jitendra Kumar Chauhan
40155	Shripad Dattatraya Dandavate
40156	Anil Kumar Banerjee
40157	Nitish Nandan Roy
40158	Kanhaiyalal Chhadamilal Chourasia
40159	Salig Ram Vasudeva
40160	Kalyan Singh
40161	Vijay Kumar Jain
40162	Santosh Kumar Jain
40163	Pritam Singh
40164	K. Madhavan Nair
40165	Rajinder Lal Mehra
40166	Sudhir Kumar Saha
40167	Nirmal Singh Kaila
40168	Kirpal Singh
40169	Nandkumar Rajaram Kanade
40170	Pramod Kumar Mittal
40171	Anand Prakash
40172	Siri Krishan Shukla
40173	Kollengode Thandava Iyer Balasubramanian
40174	Mekala Koteswara Rao
40175	Delip Kumar Mazumdar
40176	Chander Bhan Sharma
40177	Dharam Pal Madan
40178	Shashi Bhushan Kashyap
40179	Ram Krishna
40180	Ram Lubhaya Mahajan

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40181	Shivappa Somappa Nadagouda	40226	Pralhad Chintaman Kulkarni
40182	Chingleput Raghavan Mani	40227	Ac. Thakar Singh Sidhu
40183	Shankar Chandra Banerjee	40228	Suresh Chand Mittal
40184	Rajkumar Varma	40229	Gopal Krishan Joneja
40185	Devendra Kumar Maheshwari	40230	Arunkumar Hari Kulkarni
40186	Sat Paul	40231	Hari Om Agrawal
40187	Vishnu Keshav Bhat	40232	Ramdas Nagesh Vernekar
40188	Cpl. Indulal Harishanker Pandya	40233	Ram Narain
40189	Vishin Hiranand Lakhmani	40234	Sundaresan Balakrishnan
40190	Masih Ullah Khan	40235	Bhagwan Singh Saluja
40191	Raj Pal Malhotra	40236	Chander Mohan Rawal
40192	Balkrishna Ganesh Dongare	40237	Shashi Dhar
40193	Vasudevanpillai Muraleedharan Nair	40238	Niranjan Lal
40194	Maru Dinkar Khadse	40239	Rajendra Nath Tewari
40195	Parshotam Lal Behl	40240	Manohar Lal
40196	Gopal Krishan	40241	Dev Prakash
40197	Suraj Prakash Khanna	40242	Ram Kumar Srivastava
40198	Raj Kumar Anand	40243	Janardan Krishnaji Shiralkar
40199	Kashmiri Lal Kapur	40244	Prem Prakash Bhola
40200	Satish Kumar Paruthi	40245	Ishwar Datt
40201	Dibakar Haldar	40246	Gopal Krishna
40202	Atamjit Singh Jolly	40247	Dattatraya Bansi Kirtane
40203	Arvind Krishnaji Vaidya	40248	Ramakant Pathak
40204	Ram Partap Mehta	40249	Kailash Chandra Sharma
40205	Raghbir Singh	40250	Ram Lal Kalra
40206	Subhash Chandra Mittal	40251	Avtar Singh Cheema
40207	Shivaji Krishna Devardekar	40252	Kishorkumar Mavji Shah
40208	Vijai Narain Mathur	40253	Devinder Kumar Suri
40209	Kishor Ramchandra Akole	40254	Hanumant Venkoji Patil
40210	Ramji Singh	40255	Ramesh Digambar Mhaskar
40211	Ram Kanwar Basist	40256	Ram Prakash
40212	Ghura Mani Badoni	40257	Madhukar Ganpatrao Chavan
40213	Ram Dial Aggarwal	40258	J. H. Lakshminarayan Rao
40214	Surendra Kumar Bahl	40259	Mangalchand Bherudan Bhansali
40215	Shri Krishna Kaushik	40260	Sushil Kumar
40216	Vijay Kumar Kochhar	40261	Satya Paul Chopra
40217	Sodershan Kumar Vaid	40262	Romesh Kumar Bhardwaj
40218	Dattatraya Anant Panchandikar	40263	Ram Parkash Beri
40219	Shri Ram Kharbanda	40264	Thimmarasappa Ramarao
40220	Krishna Murari	40265	Cpl. Padayattil Kora Varghese
40221	Mohan Lal Goyal	40266	Vishweshwar Nagesh Bhadekar
40222	Ashok Kumar Gupta	40267	Bhimaji Martand Nimbargi
40223	Satish Chand Maheshwari	40268	Dev Raj
40224	Cpl. Bant Singh Gill	40269	Rajkumar Narayandas Laddha
40225	Surendra Kumar Jain	40270	Ramesh Bhalchandra Kher

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No.	Name
40271	Tilak Raj
40272	Brij Kishor Mathur
40273	Charanjit Singh
40274	Paru Jeswani
40275	Surjit Singh Hunjan
40276	Parameswar Ravindran Nair
40277	Surendra Kumar Agarwal
40278	Shyam Lal
40279	Pratap Singh
40280	Sgt. Jagdish Chandera Chaudhary
40281	Krishanawtar Gautamrai Datta
40282	Ramakant Narayan Dhond
40283	Laxman Namdeo Gurjal
40284	Ambika Prasad
40285	Mahesh Chandra Gupta
40286	Prabhakar Dattatraya Joshi
40287	Pranab Kumar Mukerjee
40288	Govind Ningule
40289	Vinay Kumar Chugh
40290	Yoginder Kumar
40291	Thannirkulam Rangaswamy Gopalarathnam
40292	Hashmat Ali Saiyed
40293	Karan Singh Verma
40294	Dilip Kumar Mukherjee
40295	Rasiklal Nanchanddas Shah
40296	Dhaniyala Ramachandra Naidu
40297	Hasan Ahmad
40298	Venkateswarulu Janardhana Rao
40299	Suresh Narayan Daithankar
40300	Kodali Basava Sankara Rao
40301	Kuttuva Sundararao Renga Rao
40302	Madhukar Prabhakar Shimpi
40303	Krishnaswamy Muthiahsamy
40304	Salek Chand
40305	Satish Chandra Pande
40306	Bhujendra Kumar
40307	Shyam Mohan Shrivastava
40308	K. Deva Reddy
40309	Anil Parsharam Karnik
40310	Sukumar Dutta
40311	Radha Kant Mishra
40312	Rengaswami Venkataraman
40313	Covelong Streeramulu Gandhi Baboo
40314	Venkatachari Rajagopalan
40315	S. Senthiveeran Subramanian
40316	Andh Behari Sahay
40317	Nemi Chand Jain
40318	Sudhakar Ojha
40319	Sudhakar Shridhar Joshi
40320	Naveen Chandra Agarwal
40321	A. Sivabhushanam
40322	Yashwant Vinayak Ghate
40323	Kottur Ananthaswamy Rao Dwaraki
40324	Bhoopinder Kumar Suri
40325	Sushil Kumar Saxena
40326	Girish Chandra Tewari
40327	Yogendra Nath Gautam
40328	Sankar Kumar Chakrabortty
40329	Shah Jafar Alam
40330	Mallapragada Venkateswara Sarma
40331	Suprovat Dutta
40332	Subrata Basu
40333	Manmohan Singh Chauhan
40334	Sukhendu Ghosh
40335	Dulal Chandra Jana
40336	Rabindra Nath Nanda
40337	Bhanu Prakash Govil
40338	Bisnu Bhuyan
40339	Nrusingha Charan Pradhan
40340	Ulli Baboorao
40341	Dwijaraj Dash
40342	Sachindranath Choudhuri
40343	Mohendra Nath Sarma
40344	Jagdish Lal Ghai
40345	Gopalsetty Venugopal Swamy
40346	Shiv Kanwar Singh
40347	Pijush Kanti Deb
40348	Om Prakash Sharma
40349	Lalitmohan Dehury
40350	Chandra Rao Patnaik
40351	Muhammad Misbahuddin Khan Kakarzai
40352	Subodh Ranjan Bhattacharya
40353	Narendra Nath Sarma
40354	Umesh Chandra Mahanty
40355	Kunjabihari Samantroy
40356	Anand Prakash Mathur
40357	Man Mohan Vaid
40358	Lingam Vasudeva Rao
40359	Anowar Hussain

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40360	Jagnandan Swarup
40361	Rengaswamy Sundaram
40362	Harish Chandra Gaur
40363	Ramesh Chandra Tewari
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40365	Nirmal Chandra Dey
40366	Harihar Dash
40367	Ram Parkash Goel
40368	Pitambar Baisya
40369	Josyula Narasimha Murty
40370	Radha Shyam Pal
40371	Puthenkulathil Varkey Varkey
40372	Kanuparti Nageshwar Rao
40373	Hari Krushna Mohanty
40374	Kewal Krishnan
40375	Amir Krishan Bhanota
40376	Badan Singh Rajput
40377	Vishwa Mitra
40378	Mahendera Dutt Sharma
40379	Dev Vrat Tyagi
40380	Mahavir Kumar Kothari
40381	Pradip Chandra Sarma
40382	T. K. Karunakaran
40383	Abdul Bari
40384	Jagdish Prasad Gupta
40385	Mohammed Iqbal
40386	Bhoop Singh
40387	Narra Lenin
40388	Prafulla Kumar Parida
40389	Dharm Narain Mathur
40390	Bharat Bhushan
40391	Murli D. Mirani
40392	Dipak Das Gupta
40393	Tilak Raj Khanna
40394	Konduparti Venkata Murarji
40395	Dipak Biswas
40396	Damodar Rout
40397	Laxmidhar Pal
40398	Nrusinha Charan Rautrai
40399	Rabindra Nath Ghose
40400	Sujit Kumar Das Gupta
40401	Parsurama Sahu
40402	Hadibandhu Khandual
40403	Vijaykumar Bachadeo Apte
40404	Jagabandhu Panda
40405	G. P. Sharma
40406	Nawal Kishore Chaturvedi
40407	Kunjukrishnapillai Sadasivan
40408	Mahadeo Dutta
40409	Bhikam Singh Rajesh
40410	Rajinder Paul Battish
40411	Kailash Nath Srivastava
40412	Anil Kumar Biswas
40413	Gajraj Yadav
40414	Balbir Singh
40415	Amarendra Nath Sur
40416	Satish Kumar Sharma
40417	Jugmandar Dass Jain
40418	Ramahari Mohanty
40419	Shamkant Pandharinath Mulay
40420	Vijaykumar Shankarrao Pradhan
40421	Ram Gopal Bansal
40422	Vasant Nene
40423	Arvind Ramdas Deshmukh
40424	Abdul Hameed Khan
40425	Jyotiprovab Roychowdhury
40426	Burde Bhaskar
40427	Natesa Subramaniam
40428	Jai Krishan Sood
40429	Rameshwar Prasad Bahre
40430	Yagneswar Singha
40431	Bhalchandra Gopalrao Dixit
40432	Kishor Bapurao Baxi
40433	Suresh Dattatraya Vaidya
40434	Ram Kishan
40435	Haradhan Ray
40436	Devendra Kumar Agarwal
40437	Narayan Chandra Ghatak
40438	Devulapalli Kalidas
40439	Gajanand Rao Raut
40440	Lashkar Singh
40441	Masanamuthunadar Sivaswamy Nadar
40442	Balkrishna Gajadharprasad Shrivastwa
40443	Chingakham Brajendra Singh
40444	Chandrakant Damodar Singnurkar
40445	Shankarnarayan Achari
40446	Lal Chand Gulecha
40447	Madan Mohan Pathak
40448	Khurshid Ahmad Khan
40449	Surendra Nath Lal

STUDENTS (*contd.*)

No.	Name	No.	Name
40450	Hira Lal Magazine	40495	Brij Mohan
40451	Dolagobinda Samal	40496	Brahma Prakash
40452	Farid Ahmad Khan Jamali	40497	Nagendra Prasad Saxena
40453	Jagdish Prasad Choikse	40498	Komal Chand Jain
40454	Satya Pal	40499	Prasant Kumar Rath
40455	Birendra Nath Ganguly	40500	Meharchand
40456	Narendra Kumar	40501	Vallabhdas Mahidas Jalavadia
40457	Nonvinkere Srinivasaiyengar Gopa	40502	Bal Krishen Raina
40458	Bansi Lal Panwar	40503	Padam Chandra Jain
40459	Gur Mohinder Singh	40504	Ghanshyam Lakhmichand Hemrajani
40460	Sansar Singh	40505	Radha Vallabha Gupta
40461	Chandra Shekhar Tiwari	40506	Ramesh Shankar Pathak
40462	Om Prakash Sharma	40507	Shyam Sunder Rajawat
40463	Ram Prasad Srivastava	40508	Lakhan Lal Agrawal
40464	Dinendra Kumar Jha	40509	Dev Parkash
40465	Harcharan Singh Laya	40510	Jagdish Kumar Chopra
40466	Bhagwat Singh Baxi	40511	Dattatraya Dhondopant Haldavnekar
40467	Telikicharla Sankara Rao	40512	Hungarcutta Narasimha Nayak
40468	Vinay Kumar Verma	40513	Kamod Nath Bhatt
40469	Krishna Lal Jindwani	40514	Jayantilal Narayandas Gujarathi
40470	Brij Raj Chandra	40515	Krishan Kumar
40471	Shri Pat Rao Bonde	40516	Sukhdev Singh
40472	Mahendra Kumar Tandon	40517	Sewa Singh
40473	Mallapragada Venkateswara Sarma	40518	Joginder Paul Aggarwal
40474	M. P. Vasudeva Panicker	40519	Dinesh Chandra Dutta
40475	Ajoy Kar	40520	Vishwa Nath Sharma
40476	Bata Krishna Panda	40521	Narendra Kumar Jain
40477	Ajit Kumar Kundu	40522	Ravinder Nath
40478	Subash Chand	40523	Devendra Kumar Govil
40479	Anant Gangadhar Holkar	40524	Chidambaram Subramaniam Radhakrishnan
40480	Ramesh Chandra Punjabi		
40481	Vinod Prakash Atri	40525	Raj Bahadur
40482	Saral Kumar Jha	40526	Suresh Chand Gupta
40483	Barun Kumar Sen	40527	Sudhiranjan Nath
40484	Ram Naresh Chaudhary	40528	Shri Ram Shukla
40485	Sailendranath Niyogi	40529	Nandigama Madana Mohan Rao
40486	Gangadhara Srinivasa Rao	40530	Pralhad Narsingrao Kale
40487	Kuldeep Singh Sachdev	40531	Jayant Baburao Changule
40488	Sailendra Kumar Chaudhuri	40532	Somnath Ghosh
40489	H. N. Venkatachalaiah	40533	Madan Mohan Guin
40490	Satya Narain Singh	40534	Pritpal Singh
40491	Balasubramania Vaidyanathan	40535	Mohinder Singh
40492	Narinder Nath Aggarwal	40536	Kailash Chandra Behura
40493	Hejmady Raghavendra Vittal Shenoy	40537	Subhash Vishnu Kulkarni
40494	Prit Pal Singh Puri	40538	Mast Ram

STUDENTS (*contd.*)

No.	Name
40539	Harbhajan Singh
40540	Mundanilkunnathil Philip Chacko
40541	Karam Singh
40542	Sant Ram Dhiman
40543	Inder Bhushan
40544	Chuzhikunnel Varughese Joseph
40545	Aroon Ganesh Athawale
40546	Chandulal Chunilal Mehta
40547	K. Amarjit Singh
40548	Lal Mohan Koot
40549	Bijay Bahadur Singh
40550	Gada Dhar Sharma
40551	Nurani Krishnan Sivaramakrishnan
40552	Pronab Kumar Mukherjee
40553	Gurumurthy Sambamurthy
40554	Parimal Sarkar
40555	Risal Singh
40556	Bishnu Mohan Mall
40557	Satish Kumar Gulati
40558	Monjooran Mathew Cyriac
40559	Om Parkash Malhotra
40560	Harjit Singh Rekhi
40561	Kidar Nath
40562	Mohinder Singh
40563	Gurbax Singh
40564	Srinivasasastry Balasubramanian
40565	Mohammad Ebrarul Haque Haider
40566	Avinash Shreeram Gupta
40567	Surender Singh
40568	Om Parkash Bansal
40569	Amiya Kumar Modak
40570	Kasturi Ramakrishna Rao
40571	Rasiklal Fulabhai Sheth
40572	Zobair Ahmad
40573	Arunkant Gajanan Tatu
40574	Shree Kant Pandey
40575	Ranjit Singh Dhindsa
40576	Bahadur Singh Yadava
40577	Milkhi Ram Sharma
40578	Samir Kumar De
40579	Nagendra Narayan Singh
40580	Gurcharn Singh
40581	Chaganty Subrahmanyam
40582	Raje Singh Rawat
40583	Dev Raj Wadhawan
40584	Batakrishna Mandal
40585	Dipankar Sen
40586	Purnendubikas Chaudhuri
40587	Amar Nath Saxena
40588	Surendra Dinanath Chaubey
40589	Srinivasaiyengar Raghunathan
40590	Bahadur Singh
40591	Parimalkumar Pal
40592	Bhagwan Dass Ailawadhi
40593	Seetaramarao Mohan Rao
40594	Niranjan Singh
40595	Jasbirsingh Laxmansingh Manku
40596	Ved Parkash Goyal
40597	Narinder Kumar Soni
40598	Kodungalloore Ramavarma Raja
40599	Kirpal Singh
40600	Anil Kumar Banerjee
40601	Bipinchandra Mukundray Bhatt
40602	Madhusudan Damodar Dixit
40603	Aditya Pal Singh
40604	Tez Bahadur Jain
40605	Amrit Kumar
40606	Jugal Kishore Puri
40607	Krishan Gopal Gupta
40608	Anandi Charana Sahoo
40609	Bikramjit Singh
40610	Niranjan Kishore Das
40611	Raj Paul
40612	Om Parkash Sethi
40613	Ram Babu Singh
40614	Syamal Kumar Banerjee
40615	Surinder Mohan Agnihotri
40616	Jitendra Nath Sharma
40617	Subhash Vishwambhar Chitale
40618	Arun Krishna Damle
40619	Arun Dharmajee Shirsekar
40620	Krishan Mohan Saxena
40621	Cdt. Vinod Kumar
40622	Ardamoole Mahabaleshwara Bhat
40623	George Abraham
40624	Abhoy Shankar Sarkar
40625	Gopal Singh Dhadwal
40626	Hiralal Assanmal Gajria
40627	Pandurang Laxman Ayre
40628	Hosakere Shankarasastry Shivaswamy

STUDENTS (*contd.*)

No.	Name
40629	Sat Pal Malik
40630	Suresh Bhargav Mulay
40631	Pran Kumar Pal
40632	Madhaw Prasad Sinha
40633	Harbans Singh
40634	Pothen Kandathil Samuel
40635	P. Thomas Raju
40636	Arjan Uttamchand Thadhani
40637	Vijay Hari Narvekar
40638	Noormohammed Karimbhai Karuwala
40639	Natveralal Dahyabhai Barot
40640	Suresh Chunilal Kamdar
40641	Ganpat Singh
40642	Krantikumar Vinayakrao Koratkar
40643	Vattappallimadom Hariharaiyer Narayan Iyer
40644	Om Prakash Mathur
40645	Girish Chandra Joshi
40646	Satish Narain Srivastava
40647	Shiv Lal Borana
40648	Mahaveer Gupta
40649	Jagdish Prasad Maheshwari
40650	Hem Raj Paliwal
40651	Narayan Singh Gehlot
40652	Sudhakar
40653	Shiv Shanker Goyal
40654	Surjeet Singh
40655	Manohar Lal Makkar
40656	Thakurdas Chowdhury
40657	Bhagwan Khanchand Mulani
40658	Yogendar Nath Sharma
40659	Thanwar Tanwani
40660	Parmanand Dwarkadas Galani
40661	Kuldip Raj
40662	Ramkrishna Sadashive Khare
40663	Ajit Kumar
40664	Rama Nand
40665	Pramod Kumar Yadav
40666	Pravesh Chandra Bairya
40667	Attanti Chandra Rao
40668	Hari Prasanna Gogoi
40669	Patil Venkatasiva Reddy
40670	Bimlesh Kumar Goel
40671	Ramlal Kaluram Parmar
40672	Bal Krishan
40673	Tiruvarur Venkataraman Balasubramanian
40674	Lekh Raj
40675	Hotu Udhawdas Shivnani
40676	Cpl. Renkappareddiar Venkataraman
40677	Dhan Keswani
40678	Balkrishna Duba
40679	Alok Kumar De
40680	Aryya Kumar Basu
40681	Prakash Ganesh Chakradeo
40682	Devendra Kumar Agarwal
40683	Mahesh Krishan Rathi
40684	Bankey Lal Gupta
40685	Thakur Dass
40686	Ram Tewani
40687	Kishin Bulchandani
40688	Kailash Narain Mathur
40689	B. Subramonia Iyer
40690	Bikram Singh
40691	Arabinda Kole
40692	Vishav Dev Sharma
40693	Gurcharan Dass
40694	Subhash Chander
40695	Rajendra Nath Arrodvanshi
40696	Gopal Krishan
40697	Prakash Lall Amarlal Mathur
40698	D. Shamarao Narasimha Prasad
40699	G. B. Renukappa
40700	Vistamsetty Srinivasulu
40701	Hari Prasad Yadav
40702	Om Parkash
40703	Chanchal Kumar De
40704	Ramachandra Maruti Pawar
40705	Kanwal Kishore Nayar
40706	Vadada Gajapathirao
40707	Krishnamurthi Narayana Prasad
40708	Edara Venkateswarlu
40709	Mahabir Prasad Jain
40710	Varanasi Ramamurty
40711	Madhukar Bheemrao Kulkarni
40712	Madhavrao Krishnarao Potay
40713	Elamanchili Ramamurthy
40714	Edara Mallikharjuna Rao
40715	Dhoosa Narsing Rao
40716	Mohammed Abdul Ahad
40717	Kavindra Saran Vaish

STUDENTS (*contd.*)

No.	Name
40718	Edwin Lawrence D'Souza
40719	Motkar Janardhan Reddy
40720	Gadamchetty Chandramouli Chetty
40721	Amruthaluri Chakradhara Rao
40722	Akela Shri Omkar
40723	Nallamilli Paddi Reddy
40724	Pallicherla Bhaskara Reddy
40725	Laxmi Narain
40726	Inturi Malakondaiah
40727	T. Venkata Sreerama Satyanarayana Murty
40728	Naik Abdul Azeez Khan
40729	Raimilunta Veeraswamy Rama Rao
40730	Dabbiru Ganapathi Rao
40731	Durvasula Venkata Ramana Murty
40732	Bhimarayappa Kallaraddeppa Sangalad
40733	Yelamanchili Venkata Kutumba Rao
40734	Koyyda Prakash Rao
40735	Om Parkash Malhotra
40736	Amit Kumar Roy Choudhury
40737	Soami Dayal Tandon
40738	Makam Viswanatham Gupta
40739	Pothuri Janardana Rao
40740	Maddala Raja Rao
40741	Gangadhara Kondoji Srinivas
40742	Achintya Kumar Nandi
40743	Eaturu Sreerama Murthy
40744	Mohammed Ghouse
40745	Uttam Gurudattarao Mansabdar
40746	Cpl. K. Unnikrishnan
40747	Komanduri Vijaya Sardhi
40748	Krishnaji Ayyagari
40749	Mallaiah
40750	Kattamuru Venkateswara Rao
40751	Viswanatha Padmagirisan
40752	Cpl. Jagjit Singh Kahlon
40753	Thekkadatha Ramachandra
40754	Rasaputra Deva Singh
40755	Gudala Sammaiah
40756	Vadicharla Viswanath Arya
40757	Duvvuru Bhupathi Reddy
40758	Patel Venkat Reddy
40759	Yalamanchili Sree Rama Chandra Rao
40760	Perlampady Balakrishna Shenoy
40761	Venkataiah
40762	Krishnayya
40763	Anappindi Ram Babu
40764	Thotakura Satyanandam
40765	Akumalla Ramakrishnaiah
40766	Ashit Kumar Basu Choudhuri
40767	Sayamsundar Ghosh
40768	Babulal Verma
40769	Lakharaju Sanyasi Rao
40770	Badri Markandeyulu
40771	Vasant Digambar Nene
40772	Pakki Devendra Rao
40773	Veduruparti Varaprasada Rao
40774	Jogesh Chandra Bhowmik
40775	Lakshman Shanthi Kumar
40776	Shivabasappa Gurupadappa Javali
40777	Meenakshia
40778	Jayanti Bhaskara Subba Rao
40779	Cheruvu Subrahmanya Sastry
40780	Rashid Masood Ahmed
40781	Subhash
40782	Marugu Mallesham
40783	Cpl. Swinder Singh Oberoi
40784	Aruru Paramasivachari
40785	Mallepalle Athmarami Reddy
40786	Muppidi Arron Divakara Rao
40787	Penninti Babu Rao
40788	Tulugu Paparao
40789	Laxman Gopal Panditrao
40790	Joginder Singh Villkhu
40791	Alase Santharam
40792	Nellore Venkata Seshagiri Rao
40793	Chetalapalli Ramakoti Bhaskara Rao
40794	Vaka Krishna Reddi
40795	Sunkara Venkata Subbarao
40796	Namala Suryanarayana
40797	Pami Reddy Lakshmi Reddy
40798	Braj Lal Sharma
40799	K. L. Ravindranatha Setty
40800	Musiri Ramaswami Kandaswami
40801	Ac. Charan Singh
40802	Sista Lakshmi Ganapathi
40803	Kaza Gopala Rao
40804	Gurdial Singh Suri
40805	Janardhana Vijayendra Murthy
40806	Vyayaraju Syamasundara Raju

STUDENTS (*contd.*)

No.	Name
40807	Lanu Doshi
40808	Balakrishnan Ramanathan
40809	Madarapu Ramanathan
40810	Mohammed Zakria Baig
40811	Tope Bahadur Basnyat
40812	Madabasire Venkatarama Sastri Sreehari
40813	Kalanjeri Parameshwara Srinivasan
40814	Srinivasan Krishnamurthy
40815	Ijjapureddi Venkata Ramayya
40816	Nadimpalli Satyanarayana Raju
40817	T. S. Venkata Krishna Rao
40818	Dharumapuram Maruti Mohan Rao
40819	Adigopula Panakala Rao
40820	Budamkayala Chandragupta
40821	Gian Parkash
40822	Dinesh Shivaramrao Ujre
40823	Devendra Prasad Sinha
40824	Rabindra Nath Roy
40825	Virendra Sahay
40826	Jeevan Parkash Sood
40827	Rabindra Chandra Chowdhury
40828	Satish Chandar Rampal
40829	Narasimiah Ramanna
40830	Kotagiri Venkata Rama Krishna Mohan Rao
40831	Immareddy Madhusudhan Reddy
40832	Surjit Singh
40833	Sharbat Lal Singhvi
40834	Bhairolal Sharma
40835	Valluri Seshagiri
40836	Tridibes Chakraborty
40837	Dinesh Chandra Pandey
40838	Vinaya Kumar
40839	Yugal Kishore Srivastava
40840	Amulya Kumar Banerji
40841	Prakash Masand
40842	Cpl. Nitai Das Saha
40843	Shiva Nath Chaube
40844	Omkar Nath Bhanot
40845	Prithwish Chandra Tarafder
40846	Ram Chandra Choudhury
40847	Hardial Singh Chima
40848	Parma Nand Sharma
40849	Prakash Narain Misra
40850	Narayan Dev Tripathi
40851	Subhas Chandra Joshi
40852	Prem Mohan Agarwal
40853	Satish Kumar
40854	Arvind Krishna Karmalkar
40855	Amanat Husain Hasan Ali
40856	M. R. Venkitachalam Iyer
40857	Ram Autar Gupta
40858	Narinjan Singh Dang
40859	K. V. Subramonia Iyer
40860	Bajirao Baburao Gaikwad
40861	Bundashah Charandas Sethi
40862	Puran Singh
40863	Subhas Chandra Sen
40864	Kewal Krishan Chadda
40865	Vidya Bhushan Bakshi
40866	Ramesh Kumar Sharma
40867	Avinash Khanderao Rangnekar
40868	Surendra Kumar Sharma
40869	Subhash Chandar
40870	Virendra Kumar Saxena
40871	Kantibhai Chaturbhai Patel
40872	Surjit Singh
40873	Surinder Kumar Malik
40874	Natesaiyer Revathisankar
40875	Shanker Dayal Rai
40876	Megh Raj Prabhakar
40877	Subash Chander Chopra
40878	Shri Dhar Dixit
40879	Damodar Subrao Patil
40880	Vinod Prasad
40881	Dattatraya Manik Kulkarni
40882	S. Adinarayana
40883	Darshan Kumar Sooden
40884	Badal Kumar Chakraborty
40885	Bijan Kanti Biswas
40886	Ravi Dutt Gupta
40887	S. C. Vimalakumaraiah
40888	Mohit Ranjan Choudhury
40889	Mahendra Kumar Jain
40890	Satendra Singh
40891	Narayan Prasad Soni
40892	Kishinlal Sindhi
40893	Yogesh Chanana
40894	Nitai Chandra De
40895	Ram Surat Singh

STUDENTS (*contd.*)

No.	Name	No.	Name
40896	Gangavaram Krishnamurthy Nagaraj	40941	T. S. Nagabhushana Rao
40897	Kollipara Virranarayana	40942	Sharad Keshao Kulkarni
40898	Tatty Madhusudana Rao	40943	Surajdeo Mishra
40899	Lalan Prasad	40944	Pandey Shisher Kumar Nath Roy
40900	Surendra Kumar Sinha	40945	Narugopal Gangopadhayay
40901	Hrishikesh Shaha	40946	Bijan Kumar Basak
40902	Rebati Raman Prasad	40947	Amrit Lal Gupta
40903	Satya Paul Luthra	40948	Kapur Singh Malik
40904	Mohit Lal Acharya	40949	Santi Kumar Das
40905	Jagjit Singh	40950	Jnanatosh Chattopadhyay
40906	Cpl. Balwant Singh Saggu	40951	Pijush Kanti Das
40907	Nand Kishore Sood	40952	Suresh Chandra Gupta
40908	Hara Prasad Bhattacharyya	40953	Sukumar Chel
40909	Arvind Vasudeo Chine	40954	Sushil Kumar Kundu
40910	Jogendra Pal	40955	Amarendra Prasad Ghosh
40911	Ashok Venunath Khandge	40956	Kalachand Chattopadhyay
40912	Thakar Singh Berwa	40957	Harinder Singh Virk
40913	Vithal Motiramji Shegokar	40958	Tushar Kanti Ghosh
40914	M. L. Krishna Murthy	40959	Nirmal Kumar Sarkar
40915	Ram Kumar	40960	Adinath Datta
40916	Ramesh Chander Puniani	40961	Nirmal Chandra Moitra
40917	Chandra Pal Singh	40962	Purushottam Savalaram Waghmare
40918	Padmakar Dixit	40963	Ramesh Chander Katyal
40919	Ahindra Bikash Das	40964	Upendra Narain Kumar
40920	Prem Gandhi	40965	Manyam Venkata Balasubrahmanyam
40921	Dilip Kumar Ghosh	40966	Ramesh Vinayak Godbole
40922	Prabhakar Trimbak Bhagwat	40967	Janardan Vithal Satpute
40923	Virendra Singh	40968	B. S. Ramesh
40924	Vithal Mallappa Desai	40969	Kapil Dev
40925	Ram Kumar Tiwari	40970	Ram Niwas
40926	Sunil Raychaudhuri	40971	Vasant Appaji Joshi
40927	Bimal Kumar Biswas	40972	Mohammed Shams Alam
40928	Sisir Kumar Ghose	40973	Banarsi Dass Mahajan
40929	Krishnadas Jagmohandas Lad	40974	Chaman Lal Chadha
40930	Narayan Gopal Ray	40975	Hari Dev Sheekri
40931	Prem Nath Soni	40976	Ashanand
40932	Ram Prasad Mukherjee	40977	Trilochan Singh
40933	Tapas Mallik	40978	Pesu Parasram Rijhwani
40934	Dhirendra Kumar Nath	40979	Mukund Moreshwar Deshmukh
40935	Ravindra	40980	Dalbir Singh
40936	Ajayananda Majumdar	40981	Kali Charan Sharma
40937	Koppada Sree Ramamurty	40982	Ajit Singh
40938	Taran Singh	40983	Yogeshwar Prasad Roongta
40939	Vadlamani Siva Rama Krishna	40984	Jugal Prasad Ganguly
40940	Paila Stayanarayana	40985	Narendra Kumar Jain

STUDENTS (*contd.*)

No.	Name
40986	Ramadhar Narayansingh Vyas
40987	Yermal Shankara Bhat
40988	E. Krishnan Nambûdiri
40989	Kasargod Narasimha Bhatji
40990	Bastawade Babasaheb Balavant
40991	Vasant Vithalrao Sakhalkar
40992	Jagmohan Singh Chhatwal
40993	Shyam Lal
40994	K. Parameshwar Tunga
40995	Diwakar Govindrao Bhalerao
40996	Birupaksha Pal
40997	Pramod Kumar Gulbaray
40998	S. K. Ganesan
40999	Sant Ram Narang
41000	Mohamed Nurraddin
41001	Maharudra Ishwar Magdum
41002	Harish Chand Goel
41003	Shreekrishna Bhaurudas Chopade
41004	Shriram Shankar Deshpande
41005	K. A. Madhava Menon
41006	Shashikumar Purshottam Sawkar
41007	Tolety Venkatachalam
41008	Bikasnandan Chakrabarti
41009	Pahilaj Hiranand Lala
41010	Govind Kant Varma
41011	K. M. Prahlad
41012	Purnendu Choudhury
41013	Gangadhar Venkatesh
41014	Vasant Ramchandra Jadhav
41015	Kabir Dass Dua
41016	Raghbir Singh Rana
41017	Ozi Peter Morris
41018	Puttur Sripathy Sharma
41019	Janardan Prasad
41020	G. Kanime Rangaiah
41021	Pramod Bihari Prasad
41022	Banarsi Dass
41023	Brij Mohan Mehera
41024	Charan Jit Singh
41025	Sant Kumar Shahi
41026	Cpl. Surendra Prasad Lal
41027	Indradeo Tiwary
41028	Kamal Nath Prasad
41029	Jagdish Chand
41030	Sukesh Chandra Biswas
41031	H. M. Zaheer Ahmed
41032	Ishwar Dayal Gupta
41033	Omkar Prasad Ambastha
41034	Raj Kumar
41035	Narinder Mohan Walecha
41036	Karanti Kumar Marwaha
41037	Nirmal Kumar Chatterjee
41038	Harinder Singh Ratra
41039	Banarasi Lal
41040	Mantosh Kumar Nag
41041	Roop Chand Gupta
41042	Ratis Chandra Ray
41043	Subhash Chandra Nath
41044	Sahdev Raj Kakkar
41045	Jammalamadaka Lakshmi Kantam
41046	Manjit Singh
41047	Om Prakash
41048	Kidar Nath Kainth
41049	Deb Kumar Chatterjee
41050	Mrinal Kanti Dutta
41051	Ramesh Chander Ahluwalia
41052	Amrit Lal
41053	Balbir Singh
41054	Milkha Singh
41055	Vinod Kumar
41056	Radha Raman Mandal
41057	Kuldip Singh Syal
41058	Kesho Prasad Singh
41059	Mohinder Singh Osahan
41060	Sat Pal Sharma
41061	Pathalil Mathai Thomas
41062	Cpl. Padmanabhan Parameswaran Pillai
41063	Shashi Mohan Das
41064	Gurmit Singh
41065	Raj Krishan Sharma
41066	Brij Lal
41067	Amrik Singh
41068	Vemparala Sambamurti
41069	Rajinder Singh
41070	Bhudar Nanji Gadhia
41071	Jaswant Singh Chahil
41072	Harmit Singh
41073	Debaraja Panigrahi
41074	Mitter Paul Seth
41075	Shiv Kumar Khanna

STUDENTS (*contd.*)

No.	Name	No.	Name
41076	Darshan Singh	41088	Arjun Dass Chhabra
41077	Priyottam Datta	41089	Shiv Charan Gupta
41078	Parkash Chand Jain	41090	Raja Ram
41079	Phani Bhusan Mondol	41091	Amrik Singh
41080	Milkh Raj	41092	Ram Prakash Sharma
41081	Raghubir Chandra Srivastava	41093	Bhupinder Singh Syan
41082	Shish Pal Sehgal	41094	Raj Kumar Sharma
41083	Pritpal Singh Toki	41095	Dilbag Krishan
41084	Baidyanath Mallik	41096	Cpl. Mangal Prakash
41085	Sham Dingomal Thadani	41097	Ajaib Singh Rohal
41086	Harjinder Singh	41098	Bharat Kumar
41087	Mahesh Chander	41099	Swadesh Kumar Mullick

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In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

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Require for their construction department, the following personnel :—

1. Design Engineers : Degree in Civil Engineering in First Class with experience in design of R.C.C. bridges for not less than 5 years.
2. Assistant Engineers : Degree or Diploma in Civil Engineering with considerable experience in the construction of major bridges in R.C.C. and sinking of wells.
3. Overseers : Same as above.
4. Estimators : Degree or Diploma in Civil Engineering with considerable experience in estimating and tendering for bridge works.
5. Draftsman : Diploma in Civil Engineering with experience in preparing detailed drawings for R.C.C. bridges, etc.
6. Tracers : Same as above.

SITUATIONS WANTED

ELECTRICAL ENGINEER, B.Sc. (Hon.), M.Sc. (Tech.), A.M.I.E., aged 31 years, with 7 years practical experience in the Works of a British engineering firm (including 6 months higher training in the U.K.) in assembly and testing of electrical equipments ; at present working as Foreman in assembly section employing more than 100 workers, seeks change for betterment. Present monthly income (gross) Rs. 1,100 (approx.) which includes D.A. and bonus. (Office ref. E.S. 135)

STUDENT of the Institution of Engineers (India), B.Sc. (Mathematics), B.T., passed Sections A and B of the Associate Membership Examination securing 61% and 54% marks respectively in Civil Engineering—15 months experience in teaching in a Government technical institution teaching mathematics and civil engineering subjects, one year's administrative experience as headmaster and a total teaching experience of 10 years, willing to serve anywhere in India or outside on reasonable terms ; seeks suitable position in professional or teaching line. (Office ref. E.S. 136)

GRADUATE ENGINEER, A.M.I.E., having 11 years experience in the field of overhead electrical transmission line work, well-versed in design, detailing and fabrication of lattice steel towers, sub-station structures and similar light structurals with a background of good construction experience, seeks change. Minimum starting salary at Rs. 1,000 basic in Senior Design Engineers' grade. (Office ref. E.S. 137)

YOUNG ELECTRICAL/MECHANICAL ENGINEER, 37, student of the Institution of Engineers (India), with 16 years practical experience, recently retrenched from Class II Central Service, seeks suitable employment, preferably in or around Delhi. Experienced in the installations, maintenance and repair work of I.C. engine driven generating sets, electrical motors, generation/distribution of medium power supply, switchgears, radio communications and electronics equipments, etc. Shall also be happy to work on the design/development/manufacturing of light/medium equipments, etc. (Office ref. E.S. 138)

DIPLOMA HOLDER in Electrical Engineering, 24 having undergone two years training in a big industrial concern as Government of India Junior Stipendry, and working in a research department since last three years in a permanent position. Passed Sections A and B of the Associate Membership Examination of the Institution of Engineers (India) with Electrical Machines and Measurements as optional subjects, present salary Rs. 300, salary desired between Rs. 350-450, prepared to start a fresh carrier as an apprentice or electrical engineer in any part of India. (Office ref. E.S. 139)

ASSOCIATE MEMBER of the Institution of Engineers (India), working since six years in a big river valley project in India, has got vast experience in the investigation, design and execution of various irrigation and tank works, has also got special knowledge in the design and execution of R.C.C. works, cross drainage works, and now working in a Class II position, seeks a Class I post in South or in Central India. (Office ref. E.S. 140)

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(FOR A. M. I. E. EXAMINEES)
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6. Moment Area Method, Supplement to Ch. 4 (Deflection of Beams) of 'Structural Theory & Design' .. .. Rs. 2.00

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BULLETIN OF
THE INSTITUTION
OF
ENGINEERS (INDIA)

PLEASE SEE PROGRAMME O[illegible] ANNUAL CONVENTION,
HYDERABAD, FE[illegible] 8-13, 1964,
IN THE [illegible]IN

Vol. 13, No. 3, NOVEMBER 1963

Supplement to the *Journal of the Institution of Engineers* (*India*),
Vol. 44, No. 3, November 1963

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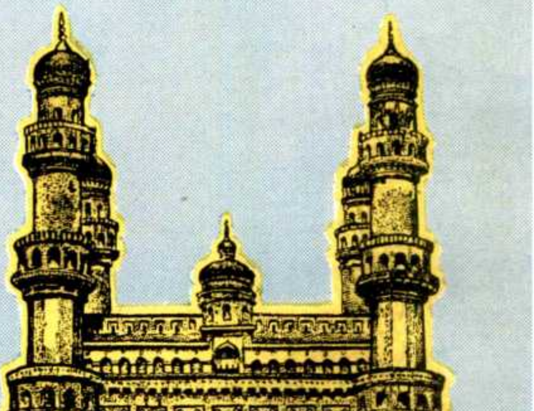
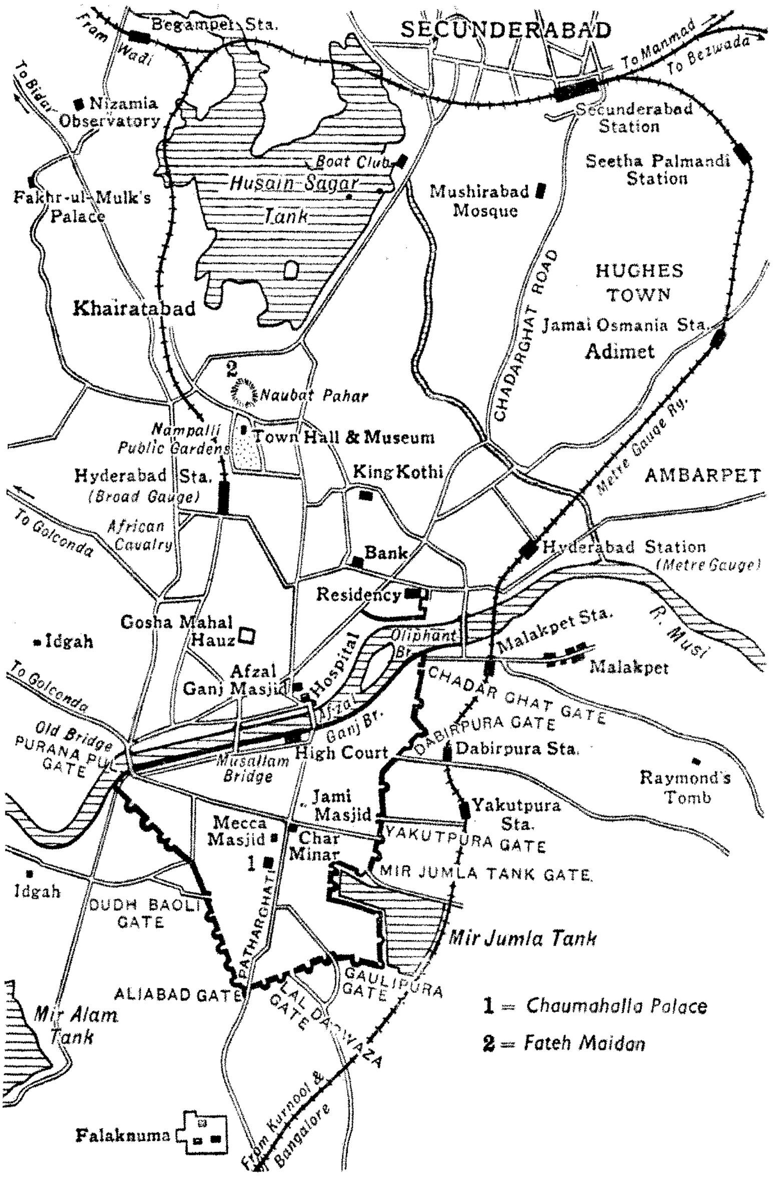
Welcome to

44TH annual convention



HYDERABAD

February 8-13, 1964



A Guide Map of Hyderabad

FORTY-FOURTH ANNUAL CONVENTION
HYDERABAD
FEBRUARY 8-13, 1964

The 44th Annual Convention will take place in Hyderabad between February 8 and 13, 1964.

The Andhra Pradesh Centre, who will be the hosts on the occasion, extend a cordial invitation to you. The Organizing Committees of the Centre, appreciative of the needs of the Convention participants, are making the necessary arrangements to make your stay pleasant and interesting. Following the traditions of the previous Conventions, the programme has been planned to include, besides technical meetings and symposia in the various Divisions and Groups, social entertainment and sightseeing and informative excursions in and around the charming surroundings of the city for the delegates and their ladies. In order to ensure that this visit to Hyderabad is a pleasurable experience, participants are requested to complete and positively return the Acceptance Form at the end of this programme indicating their acceptance on or before January 20, 1964, so that the required reservations are taken care of well in advance.

Attention is particularly invited to the fact that rail concession had been withdrawn by the Railway Board due to the National Emergency, but efforts were being made to secure the concession.

A request was made to the Railway Board again this time for a resumption of the rail concession to delegates attending the 44th Annual Convention of the Institution at Hyderabad. Members will be glad to know that the Railway Board has agreed to make rail concession available to persons attending this Convention. The conditions of the rail concession and the Certificate Form to be filled by intending delegates to obtain the concession are given at the end of this programme.

THE ANNUAL GENERAL MEETING

Business Session

The Business Session of the 44th Annual General Meeting will be held at 3.00 p.m. on Saturday, February 8, 1964, in the building of the Andhra Pradesh Centre, Institution of Engineers (India), Khairatabad, Hyderabad 4.

Inaugural Session

The Inaugural Session of the 44th Annual General Meeting will be held at 9.00 a.m. on Sunday, February 9, 1964, at Gandhi Bhavan, Mozamjahi Market Road, Hyderabad. Dr. K. L. Rao, M.I.E., Minister for Irrigation and Power, Government of India, will inaugurate the Convention.

The Seventh Sir Mokshagundam Visvesvaraya Lecture will be delivered by an eminent person on the same day at 11.15 a.m. This Lecture was initiated and established by the Institution in 1957 : 'To honour the outstanding achievements of Sir Mokshagundam Visvesvaraya in the field of engineering, the Lecture will deal with a cultural subject allied to engineering and will be of interest to all engineers'.

Paper Meetings and Symposia

An extensive technical programme facilitating open discussion on nearly 80 papers to be presented at the Paper Meetings in four sessions, thus providing interesting material for free exchange of professional knowledge in the several branches of engineering embraced in the Institution's technical activities, is a major feature during the Convention. The programme covers many subjects of importance. Included in the schedule are two Symposia—one under the Civil Engineering Division and another proposed by the Engineering Research Committee of the Institution, designed specifically to be of general interest. The former is expected to review the contributions engineering and science have made in the advancement and economic development of 'Concrete Construction' in the altering pattern of community requirements. It is intended to cover many aspects of concrete construction, the design aspects however being excluded.

The new conditions imposed by the dispersal of industry and the compelling factors for a creative technological environment have posed many challenges. There is no gainsaying that small scale and cottage industries play a vital role in a developing economy. Engineering research holds the key to further their advance, to lay out methods for applying its findings to operating problems, and to diversify the overall pattern of industrialization to meet changing orders. The latter symposium concerns an effort to bring into analysis the concept of 'Small Scale Industries', and in this context, to consider the problems associated with them, to give an insight into the strides made by these industries thus far, and to discuss the part the Institution can play to assist research and to carve the increasing significance of small scale industries in the economic programme, so to prune their resources to effective and efficient use.

Details of these Symposia are notified in the *Bulletin* for October 1963 on pages 26 to 31 .

PROGRAMME

Thursday, February 6, and Friday, February 7, 1964

12.00 noon to 5.00 p.m.	Registration of local members at the Andhra Pradesh Centre, Khairatabad, Hyderabad 4

Saturday, February 8, 1964

9.00 a.m. to 1.00 p.m. 2.00 p.m. to 4.00 p.m.	Registration of outstation members at the Andhra Pradesh Centre

10.00 a.m.	Meeting of the Indian National Committee for the World Power Conference at the Andhra Pradesh Centre
2.30 p.m. to 3.00 p.m.	Adjourned meeting of the 1962-63 Council at the Andhra Pradesh Centre
3.00 p.m. to 4.00 p.m.	Business Session of the 44th Annual General Meeting at the Andhra Pradesh Centre
5.00 p.m. to 8.00 p.m.	Students' Session—(1) General, and (2) Technical

Sunday, February 9, 1964

9 .00 a.m. to 1.00 p.m.	Registration of outstation members at Gandhi Bhavan, Mozamjahi Market Road, Hyderabad
9.00 a.m.	Inaugural Session of the 44th Annual General Meeting at Gandhi Bhavan
11.15 a.m.	Seventh Sir M. Visvesvaraya Lecture
1.00 p.m.	Lunch
2.30 p.m. to 4.30 p.m.	Address by Chairmen and Paper Meetings
5.00 p.m. to 6.00 p.m.	Popular Lecture
8.00 p.m.	Annual Dinner

Monday, February 10, 1964

9.00 a.m. to 1.00 p.m. (Tea at 11.00 a.m.)	Paper Meetings and Symposium on 'Small Scale Industries'
1.00 p.m.	Lunch
2.00 p.m. to 4.00 p.m.	Symposium on 'Concrete Construction' in the Civil Engineering Division and Paper Meetings
5.00 p.m. to 7.00 p.m.	Variety Entertainment at Rabindra Bharati
8.00 p.m.	Dinner

Tuesday, February 11, 1964

9.00 a.m. to 1.00 p.m. (Tea at 11.00 a.m.)	Paper Meetings/Symposium in Civil Engineering Division, and Paper Meetings
1.00 p.m.	Lunch
2.30 p.m. to 4-00 p.m.	Meeting of the 1963-64 Council at the Andhra Pradesh Centre
4.00 p.m. to 5.00 p.m.	Closing Session
5.00 p.m.	At Home
8.00 p.m.	Dinner

Wednesday, February 12, 1964

Local visits and commencement of outstation tour.

Thursday, February 13, 1964

Return from outstation tour and dispersal.

OUTSTATION TOUR

An outstation tour to the Nagarjunasagar project site has been arranged. As the number of delegates that can be accommodated in the tour is limited, priority of registration is necessary and registration will be made only on receipt of full payment. Delegates will have to bring their own bedding for the tour.

Wednesday, February 12, 1964	Leave Hyderabad at 8.30 a.m. and reach Nagarjunasagar at 12.30 p.m. Lunch at Nagarjunasagar. Visit to works at Nagarjunasagar Dam from 2.00 p.m. Dinner and halt for the night at Nagarjunasagar.
Thursday, February 13, 1964	Visit to Nagarjunakonda after breakfast. Inspection of relics. Lunch at Nagarjunasagar. Leave Nagarjunasagar at 1.00 p.m. and reach Hyderabad at 5.00 p.m.

LOCAL VISITS

The following Local Visits have been arranged. Delegates are requested to select one out of them. The number of delegates that can be accommodated on each visit is necessarily restricted for the facility of inspection. Delegates may please indicate an alternative choice.

Wednesday, February 12, 1964

(a) *Visit No. 1*

- (i) Visit to Allwyn Metal Works, Ltd. (constructors of bus bodies and manufacturers of refrigerators, hospital equipment, etc.)
- (ii) Jay Engineering Corporation (manufacturers of zigzag sewing machines)

(b) *Visit No. 2*

- (i) Visit to Praga Tools Corporation (machine tools industry).
- (ii) Visit to E.M.E. School (South) and Number 1 E.M.E. Centre (electrical, mechanical and electronics engineering training institutions of the army)

(c) *Visit No. 3*

- (i) Visit to Industrial Estate, Sanathnagar
- (ii) Visit to Salar Jung Museum and Char Minar (tickets will be provided.)

Andhra Pradesh Centre, Khairatabad, Hyderabad

GENERAL NOTES

1. Registration Fee

Registration of local members will start at the Andhra Pradesh Centre, Khairatabad, Hyderabad 4, at 12 noon each day on Thursday, February 6 and Friday, February 7, 1964. For the convenience of outstation delegates and accompanying persons, facilities for registration will be open at the Institution office from 9.00 a.m. on Saturday, February 8, 1964, and at Gandhi Bhavan, from 9.00 a.m. on Sunday, February 9, 1964. Delegates planning to attend the Convention are requested to ensure in their own interest that the Acceptance Form complete in every respect and the necessary remittance are received by the Andhra Pradesh Centre latest by **January 20, 1964.** The registration fee is :

Corporate members and Graduates	.. Rs. 15.00 each
Students	.. Rs. 8.00 each

2. Annual Dinner

The Annual Dinner will be held on Sunday, February 9, 1964, at 8.00 p.m. The venue will be announced at the time of the Convention. The charges payable for the Annual Dinner are :

Corporate members, Graduates and their Gentlemen Guests	.. Rs. 15.00 each
Students	.. Rs. 10.00 each
Lady Guests	.. Rs. 10.00 each

3. Local Visits and Outstation Tour

As outlined earlier, interested delegates may please indicate their choice of visit and send the appropriate payments as under .

Local Visits	.. Rs. 5.00 per delegate per visit
Outstation Tour	.. Rs. 30.00 per delegate (this includes transportation, accommodation for one night, and boarding charges).

4. Transportation

A consolidated charge of Rs. 10.00 will be levied for each delegate availing the transportation arrangements made by the Andhra Pradesh Centre during the Convention, exclusive of the charge for Local Visits. The above charge includes conveyance from railway station to place of lodging and from place of lodging to meeting places, etc.

5. Ladies' Programme

A separate programme for ladies accompanying members is being arranged and a charge of Rs. 15.00 will be collected from each delegate accompanied by a lady. This will include all the facilities arranged during the Convention, including the special visits for ladies but excluding the Annual Dinner, Outstation Tour and hotel charges.

6. Arrangements for Return Journey

Reservation for the return journey of the delegates will be arranged, if the exact date of departure to their places of destination is intimated sufficiently in advance. Local travel agents are in charge of these arrangements. They will charge their usual service charge of Rs. 5.00 per ticket for this facility.

LADIES' PROGRAMME

The following visits have been arranged for ladies. The delegates will be informed of the detailed programme later.

(*a*) *Visit No. 1*

- (i) Visit to Nirmal Works at Khairatabad
- (ii) Visit to Hyderabad Handicrafts Emporium

(*b*) *Visit No. 2*

- (i) Visit to Salar Jung Museum
- (ii) Visit to Char Minar

(*c*) *Visit No. 3*

Conducted shopping (specially for items such as Hyderabad bangles, Bidri work articles, Peddapuram silk sarees, etc.)

GRANT OF CASUAL LEAVE FOR GOVERNMENT OFFICERS ATTENDING MEETING OF SCIENTIFIC ASSOCIATIONS

An extract from Notifications No. 74 (4)/-50-SR. III, dated July 29, 1951, printed in the *Bulletin*, vol. 1, no. 1, September 1951, p. 28, and No. 27(7)/53-SR. III, dated December 10, 1953, printed in the *Bulletin*, vol. 3, no. 3, March 1954, p. 14, issued by the Ministry of Natural Resources and Scientific Research, Government of India, in regard to the grant of casual leave to such officers as desire to attend meetings of scientific associations is reproduced below for information :

'.........subject to the exigencies of Government business, Government servants who are invitees, members, official delegates to the organization concerned or have been asked to read papers at a conference may be given facilities to attend meetings organized by scientific associations like The Indian Science Congress Association, The National Institute of Science of India, The Institution of Engineers (India), The Indian Academy of Sciences, Bangalore, and other similar bodies, by the grant to them of special casual leave to the extent required for attendance at the meetings and for journeys to and from the places of meeting. It is requested that if there is no objection, requests from individual Government servants for leave to attend meetings of scientific associations may be disposed of in the light of this decision.'

ACCOMMODATION

To the travelling visitor, Hyderabad has many striking spectacles to offer. It houses many treasures of the past, its environs abound in numerous historical and scenic sights. Though the city, being one of the principal cities in the country and the present capital of Andhra Pradesh, has large and modern as well as several small but convenient hotels, and other additional facilities, all easily accessible to the Convention grounds, the Convention period being part of the tourist season, hotel accommodation in Hyderabad and Secunderabad is likely to be somewhat limited. Provision is being made to accommodate the delegates in the hotels listed in the following pages. Their address, style, rates, telephone number, etc. are also furnished to assist the intending delegates in the selection and reservation of accommodation of their choice ahead, so to avoid last minute disappointments.

Members are therefore particularly requested to remit the hotel charges as early as possible, but, at any rate, as to reach not later than **January 20, 1960**, to the Honorary Secretary, Andhra Pradesh Centre, The Institution of Engineers (India), Khairatabad, Hyderabad 4, for the number of days for which accommodation is desired, specifying the name of the hotel. Accommodation will be necessarily allotted strictly in the order of priority of applications received and no accommodation can be assured on applications received after this date. It is advisable that members furnish an alternative choice of accommodation, to ensure that in case their first choice is not available, it is possible to offer them alternative accommodation.

ACCOMMODATION

As the Convention period falls within the tourist season, hotel accommodation in Hyderabad and Secunderabad is likely to be somewhat limited. Members are requested to remit to the Honorary Secretary, Andhra Pradesh Centre, The Institution of Engineers (India), Khairatabad, Hyderabad-4, the hotel charges for the number of days for which accommodation is required as early as possible, specifying the name of the hotel. Alternative choice of hotel may also be furnished.

Accommodation at	Number of beds and style	Rate per day			
		Single-room		Double-room	
		Boarding and lodging	Lodging only	Boarding and lodging	Lodging only
		Rs.	Rs.	Rs.	Rs.
1. **Ritz** Hill Fort Place, Hyderabad *Telephone* 33571	20 Western (non-vegetarian)	25 to 40	—	70 to 90	—
2. **Rock Castle** Jubilee Hills, Hyderabad *Telephone* 32902	3 Western (non-vegetarian)	25 to 35	—	50 to 60	—
3. **Percy's** Patel Road, Secunderabad *Telephone* 72106	30 Western (non-vegetarian)	25 to 35	—	50 to 60	—
4. **Taj Mahal** King Kothi, Hyderabad *Telephone* 33401	25 Indian (vegetarian)	—	7 to 9	—	12 to 15

Accommodation at	Number of beds and style	Rate per day			
		Single-room		Double-room	
		Boarding and lodging	Lodging only	Boarding and lodging	Lodging only
			Rs.		Rs.
5. **Taj Mahal** Narayanguda, Hyderabad *Telephone 32136*	15 Indian (vegetarian)	—	7 to 9	—	12 to 15
6. **Taj Mahal** Sarojinidevi Road, Secunderabad *Telephone 72561*	10 Indian (vegetarian)	—	7 to 9	—	12 to 15
7. **Brindavan** Station Road, Nampally, Hyderabad *Telephone 43381*	30 Indian (vegetarian)	—	5 to 7	—	10 to 15
8. **Neo Mysore Cafe** Station Road, Nampally, Hyderabad *Telephone 42541*	4 single 12 double Indian (vegetarian)	—	3.50	—	9
9. **Hotel Palace** Station Road, Nampally, Hyderabad *Telephone 32486*	2 single 5 double Indian (vegetarian)	—	6	—	12
10. **Royal Hotel** Opposite Nampally Railway Station, Hyderabad *Telephone 35333*	5 single 5 double Indian (non-vegetarian)	—	5	—	8

Accommodation at	Number of beds and style	Rate per day			
		Single-room		Double-room	
		Boarding and lodging	Lodging	Boarding and lodging	Lodging only
			Rs.		Rs.
11. **Navyuga** Nampally Station Road, Hyderabad *Telephone 42305*	15 Indian (non-vegetarian)	—	5	—	8
12. **Fateh Maidan Club** Fateh Maidan, Hyderabad *Telephone 30161*	28 Indian (non-vegetarian)	—	10	—	—
13. **New Mysore Cafe** Abid Road, Hyderabad *Telephone 42375*	6 Indian (vegetarian)	—	3 to 4	—	5 to 6
14. **Legislator's Hostel** Hill Fort, Hyderabad *Telephones 32924, 34056* and *32382*	60 Indian (non-vegetarian and vegetarian)	—	3	—	—
15. **Municipal Choultry** Nampally Railway Station, Hyderabad *Telephone 34410*	28 (lodging only)	—	2 to 4	—	—

NOTE :—1. Hotel reservation will be made only if accompanied by full remittance for the total number of days of stay.

2. Rebates are not given for meals taken outside by hotels which have included boarding charges.

3. In vegetarian hotels, breakfast, lunch and dinner are available on payment of normal charges. The charge for single meal is about Rs. 1.50.

4. In case requisition for reservation is received very late, lodging arrangements for delegates can be made in some of the newly constructed buildings at Hyderabad. In that case, they will have to make their own arrangements for their requirements.

RAIL CONCESSION

The Certificate Form for rail concession is attached at the end of this programme. Members attending the Convention and desirous of availing the concession are requested to fill in and send the Form to the Secretary at the Institution Headquarters Office in Calcutta early, to get it certified.

As regards the rail concession, members will please remember that :

(1) The concession is available only for to and fro journey by the shortest route between the railway station where the journey commences and Hyderabad.

(2) The concession is available only to the Member's person, and cannot be extended to his lady or family.

(3) The Railway Board have authorized only the Secretary to issue the Certificate.

(4) The Railway Board require that a Letter of Authority should first be obtained from an authorized Officer of the Railways, who is generally the Chief or District or Divisional Commercial Superintendent, which should be produced to the Station Master of the Railway Station where the journey commences. *Members resident at small stations are particularly invited to note this as the Station Masters themselves are not authorized to admit the concession.*

(5) The Railway Board require that the Institution should submit a statement after the Annual General Meeting, as to how many members availed themselves of the concession. **The continuance of the concession is dependant on the submission of this statement to the Board.** Members are, therefore, requested to (a) fill in the slip attached to the Certificate Form and return it to the Headquarters after the Annual General Meeting ; and also (b) to state if they availed of the concession in the special column which will be provided by the Andhra Pradesh Centre in the Registration Books at Hyderabad. **These two requirements are most important.**

(6) The certificate is not issued to those whose travelling expenses are borne by the Central/State Government or a local body or a Statutory Authority.

(7) The concession is admissible only to persons travelling from beyond 400 km. from the place of the Convention.

PROGRAMME OF PAPER MEETINGS AND SYMPOSIA

The programme of the Paper Meetings and Symposia to be held from February 9 to 11, 1964 during the Convention is given below.

Engineering Division/Group	February 9, 1964	February 10, 1964		February 11, 1964
	2.30 p.m. to 4.30 p.m.	9.00 a.m. to 1.00 p.m.	2.00 p.m. to 4.00 p.m.	9.00 a.m. to 1.00 p.m.
Civil	Paper Meetings	Paper Meetings	Symposium	Symposium/ Paper Meetings
Mechanical	Paper Meetings	Paper Meetings		
Electrical			Paper Meetings	Paper Meetings
Electronics and Telecommunication/ Automatic Control	Paper Meetings	Paper Meetings/ Symposium		
Chemical			Paper Meetings	Paper Meetings
Mining and Metallurgy	Paper Meetings	Paper Meetings		
Public Health			Paper Meetings	Paper Meetings
Structures Group 1 —Prestressed Concrete, and Structures Group 2 —Shell Structures		Paper Meetings		
Railway			Paper Meetings	
Roads and Road Transportation	Paper Meetings			
Industrial Engineering				Paper Meetings
Marine Engineering and Shipbuilding/ Nuclear Engineering			Paper Meetings	
Petroleum Engineering	Paper Meetings			
Symposium on 'Small Scale Industries'		Symposium		

Tea break at 11.00 a.m.

The Chairs of Railway Engineering, Aeronautical Engineering and Nuclear Engineering Groups are vacant at present. There are no papers for discussion in the Aeronautical Engineering Group. A paper received for presentation in the Nuclear Engineering Group is included in the Paper Meetings of the Marine Engineering and Shipbuilding Group.

SCHEDULE FOR PAPER MEETINGS AND SYMPOSIA

Sunday, February 9, 1964, 2.30 p.m. to 4.30 p.m.

Civil Engineering Division—Paper Meetings (1st Session)

(1) Address by Prof. N. S. Govinda Rao (*M.*), *Retiring Chairman*

(2) 'Recent Advances in Soil Engineering' by Dinesh Mohan (*M.*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

(3) 'Bearing Capacity of Single Pile by Static Penetration Test' by M. Raghunandan (*Student*) (*Journal*, vol. 43, no. 9, pt. CI 5, May 1963)

(4) 'A New Method for the Analysis of Stability for Earth Dams' by Dr. J. Purushotham (*A.M.*) (*Journal*, vol. 43, no. 9, pt. CI 5, May 1963)

(5) 'Stabilization of *Mar* Soil' by D. N. Bhargava (*Non-member*) and A. N. Harkauli (*A.M.*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(6) 'Measurement of Thermal Resistivity of Soils at Chittaranjan' by M. L. Gupta (*Non-member*) and B. C. Roychaudhuri (*Non-member*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(7) 'Dynamic Formula and End Bearing Piles' by Y. S. Sane (*A.M.*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(8) 'Vertical Stress Computation in the Soil by Westergaard's Equation' by K. B. Agarwal (*Non-member*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

Mechanical Engineering Division—Paper Meetings (1st Session)

(1) Address by Shri T. R. Gupta (*M.*), *Retiring Chairman*

(2) 'Trends in Manufacturing Processes and Design of Machine Tools—a Challenge to Production Management' by S. K. Basu (*A.M.*) and Prof. R. Mishra (*M.*) (*Journal*, vol. 43, no. 5, pt. ME 3, January 1963)

(3) 'Application of a Commercial Diesel Engine for Measuring Cetane Number' by V. Lakshminarayanan (*M.*), B. L. Maheshwari (*Non-member*) and K. P. Mathur (*A.M.*) (*Journal*, vol. 43, no. 7, pt. ME 4, March 1963)

(4) 'Distributive Nature of Kinetic Coefficient of Friction at Chip-Tool Interface' by A. K. Majumdar (*Non-member*), N. Ramaswamy (*Non-member*) and A. Bhattacharrya (*A.M.*) (*Journal*, vol. 43, no. 7. pt. ME 5, March 1963)

Electronics and Telecommunication Engineering Division—Paper Meetings (1st Session)

(1) Address by Dr. A. K. Chatterjee (*M.*), *Retiring Chairman*

(2) 'One-Operational Amplifier Simulates Third Order Systems with Simple Lead' by L. K. Wadhwa (*Non-member*) (*Journal*, vol. 43, no. 5, pt. ET 2, January 1963)

(3) 'Speed of Transmission of Phonetic Printed English' by S. Balaram (*A.M.*) (*Journal*, vol. 44, no. 1, pt. ET 1, September 1963)

(4) 'Phase Compensation of a Third Order Type-1 Control System' by V. Seshadri (*A.M.*) (*Journal*, vol. 44, no. 1, pt. ET 1, September 1963)

Mining and Metallurgy Division—Paper Meetings (1st Session)

(1) Address by Dr. M. N. Dastur (*M.*), *Retiring Chairman*
(*Details to be announced later.*)

Roads and Road Transportation Group—Paper Meetings

(1) Address by Shri S. R. Mehra (*M.*), *Chairman*

(2) 'Some Suggestions for Improvement in the Construction Techniques of Future Roads' by Dr. M. L. Puri (*Non-member*) and N. R. Srinivasan (*Non-member*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(3) 'Research on Foundation Analysis of Highway Fills on Soft Clays' by T. K. Natarajan (*Non-member*) (*to be published*)

(4) 'Study of Anionic and Cationic Bitumen Emulsion' by N. K. Vaswani (*A.M.*) (*to be published*)

(5) 'Design of Speed Change Lanes' by S. Koteswararao (*Non-member*) (*to be published*)

(6) 'Planning of Highway System in Assam' by G. C. Sharma (*M.*) (*to be published*)

Petroleum Engineering Group—Paper Meetings

(1) Address by Shri R. D. Varma (*M.*), *Chairman*
(*Details to be announced later*)

Monday, February 10, 1964, 9.00 a.m. to 1.00 p.m.

Civil Engineering Division—Paper Meetings (2nd Session)

(9) 'Drag on a Rough Oscillating Plate' by Dr. S. K. Baruah (*A.M.*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

(10) 'Methods for Estimation of Ground Water Storage' by S. Subba Rao (*A.M.*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

(11) 'Expansive Sub-Critical Flow in Open Channel Transitions' by R. S. Chaturvedi (*M.*) (*Journal*, vol. 43, no. 9, pt. CI 5, May 1963)

(12) 'Exit Loss in a Sharp Edged Pipe' by B. S. Basavarjaiah (*A.M.*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(13) 'Coefficient of Discharge for Standard Sharp-Crested Weirs' by Prof. N. S. Govinda Rao (*M.*) and D. Muralidhar (*Non-member*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(14) 'Drag on a Hemispherical Element in Open Channel Flow' by Dr. A. G. Mirajgaokar (*Non-member*) (*Journal*, vol. 43, no. 5, pt. CI 3, January 1963)

(15) 'Flume Studies of Drag on Bridge Piers' by A. G. Mirajgaokar (*Non-member*) and B. Suryanarayana (*Non-member*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(16) 'Hydraulic Design Criteria of Simple Type Wave Generators' by Nikhilesh Roy (*Non-member*) and S. N. Ghosh (*Non-member*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(17) 'Design of Anchored Bulkheads' by V. N. S. Murthy (*A.M.*) (*Journal*, vol. 43, no. 5, pt. CI 3, January 1963)

(18) 'Design of Rubble Mound Breakwaters' by Maj. G. N. Bajpai (*A.M.*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(19) 'Training of the Tawi River' by Dr. H. L. Uppal (*M.*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(20) 'Maximum Flood Discharge' by K. B. Khushalani (*Non-member*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

(21) 'Experimental Investigation of Wave Action on Sand Beach' by S. N. Ghosh (*Non-member*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

Mechanical Engineering Division—Paper Meetings (2nd Session)

(continued from February 9, 1964)

(5) 'Stability of a Simple Surge Tank with a Long Penstock' by R. N. Ingle (*Non-member*) and A. K. Chaudhuri (*A.M.*) (*Journal*, vol. 43, no. 9, pt. ME 5, May 1963)

(6) 'Stability Analysis of Composite Surge Tanks' by R. N. Ingle (*Non-member*) and A. K. Chaudhuri (*A.M.*) (*Journal*, vol. 43, no. 11, pt. ME 6 , July 1963)

(7) 'Power Plant Superheater and Its Design Criteria' by S. Roy (*Non-member*) (*Journal*, vol. 44, no. 1, pt. ME 1, September 1963)

(8) 'Combustion in a Spark Ignition Engine' by A. P. Agarwal (*Non-member*), A. Venkata Raman (*Non-member*) and K. D. S. R. Somayajulu (*Non-member*) (*Journal*, vol. 44, no. 1, pt. ME 1, September 1963)

Electronics and Telecommunication Engineering Division—Paper Meetings/Symposium (2nd Session)

(*continued from February 9, 1964*)

(5) 'Nonlinear Compensation of a Third Order Type-1 Control System' by V. Seshadri (*A.M.*) (*Journal*, vol. 44, no. 5, pt. ET 2, January 1964)

(6) 'One Operational Amplifier for Fourth Order Systems' by G. K. Aggarwal (*Non-member*) (*Journal*, vol. 44, no. 5, pt. ET 2, January 1964)

(7) 'One-Operational Amplifier Simulates Fourth Order Systems with Simple Lead' by L. K. Wadhwa (*Non-member*) and Maj. S. P. Sharma (*Non-member*) (*Journal*, vol. 44, no. 5, pt. ET 2, January 1964)

(8) 'Galvanomagnetic Effects in Semi-Conductor Diodes' by B. S. V. Gopalam (*Non-member*) (*Journal*, vol. 44, no. 5, pt. ET 2, January 1964)

(*Details of Symposium to be announced later.*)

Mining and Metallurgy—Paper Meetings

(*continued from February 9, 1964*)

Structures Group 1—Prestressed Concrete, and Structures Group 2—Shell Structures—Paper Meetings

(1) Address by Shri N. N. Purandare (*M.*), *Chairman*

(2) Address by Shri G. S. Ramaswamy (*M.*), *Chairman*

(3) 'An Approximate Bending Theory for Deep Shells' by S. P. Sharma (*Non-member*) and M. N. Keshava Rao (*Non-member*) (*Journal*, vol. 44, no. 3, pt. CI 2, November 1963)

(4) 'Continuous Northlight Folded Plate Roof for the Indo-Swiss Training Centre for Precision Mechanics, Chandigarh' by G. S. Ramaswamy (*M.*) and N. G. Tamhankar (*Non-member*) (*Journal*, vol. 44, no. 3, pt, CI 2, November 1963)

(*Details to be announced later.*)

Symposium on 'Small Scale Industries'

(*proposed by the Engineering Research Committee*)
(*Details to be announced later.*)

Monday, February 10, 1964, 2.00 p.m. to 4.00 p.m.

Civil Engineering Division—Symposium (3rd Session)

Symposium on 'Concrete Construction'
(*Details to be announced later.*)

Electrical Engineering Division—Paper Meetings (1st Session)

(1) Address by Prof. M. V. Deshpande (*M.*), *Retiring Chairman*

(2) 'Generalized Circuit Theory of Electrical Machines—1' by C. V. Govinda Rao (*A.M.*) and R. M. Mathur (*Non-member*) (*Journal*, vol. 43, no. 8, pt. EL 4, April 1963)

(3) 'Generalized Circuit Theory of Electrical Machines—2 : Power and Torque' by C. V. Govinda Rao (*A.M.*) and R. M. Mathur (*Non-member*) (*Journal*, vol. 43, no. 12, pt. EL 6, August 1963)

(4) 'Tidal Power Schemes' by B. R. R. Iyengar (*M.*) (*Journal*, vol. 43, no. 12, pt. EL 6, August 1963)

(5) 'Impedance Method of Detection of Shorted Turns in Turbo-Generator Field Windings' by D. R. Kohli (*Non-member*) (*Journal*, vol. 43, no. 4, pt. EL 2, December 1962)

Chemical Engineering Division—Paper Meetings (1st Session)

(1) Address by Dr. V. M. Dokras (*M.*), *Retiring Chairman*

(2) 'Evaluation of Domestic Fuel Situation in India and Some Practical Measures to Meet It' by E. G. K. Rao (*A.M.*) (*Journal*, vol. 43, no. 6, pt. CH 2, February 1963)

(3) 'Design of Pulverized Coal Flame for Boilers' by R. K. Chakravorti (*Non-member*) and S. G. Mukherjee (*Non-member*) (*Journal*, vol. 43, no. 10, pt. CH 3, June 1963)

(4) 'Heat Recovery from Sulphate Black Liquor Solids' by H. P. Didwania (*Graduate*) (*Journal*, vol. 44, no. 2, pt. CH 1, October 1963)

(5) 'Trend in the Utilization of Coal Resources in India for Thermal Generation of Electricity' by S. B. Sarkar (*A.M.*) (*Journal*, vol. 44, no. 2, pt. CH 1, October 1963)

Public Health Engineering Division—Paper Meetings (1st Session)

(1) Address by Shri R. S. Mehta (*M.*), *Retiring Chairman*

(2) 'Studies on the Effect of Direct Aeration on the Improvement of Sanitary Quality of Water in Kidderpore Docks, Calcutta' by I. Radhakrishnan (*Non-member*) and S. Chakravorti (*Non-member*) (*Journal*, vol. 43, no. 10, pt. PH 1, June 1963)

(3) 'High Rate Filtration at Municipal Water Treatment Plants' by S. R. Kshirsagar (*A.M.*) (*Journal*, vol. 43, no. 10, pt. PH 1, June 1963)

(4) 'Lactose Assimilation in Sewage Micro-Organisms' by K. Krishnamacharyulu (*A.M.*) and T. Shivaji Rao (*Non-member* (*Journal*, vol. 44, no. 2, pt. PH 1, October 1963)

Railway Engineering Group—Paper Meetings

(1) 'Trends in Wagon Design on Indian Railways' by P. C. Neogi (*M.*) (*Journal*, vol. 43, no. 11, pt. CI 6, July 1963)

(2) 'Development of Bogies for Railway Rolling Stock' by P. C. Neogi (*M.*) (*Journal*, vol. 44, no. 3, pt. CI 2, November 1963)

(3) 'Modern Welded Track for High Speed' by R. C. Bhandari (*A.M.*) (*to be published*)

(4) 'Track Drainage' by P. N. Mehta (*Non-member*) (*to be published*)

(5) 'Regirdering of Bridges on Railways' by N. H. Subramania Iyer (*Student*) (*to be published*)

(6) 'Studies on Railway Accidents' by T. C. Sarkar (*Non-member*) (*to be published*)

Marine Engineering and Shipbuilding Group—Paper Meetings

(1) Address by Shri S. Basu (*M.*), *Chairman*

(2) 'Progress in the Development of Nuclear Power for Ship Propulsion' by S. K. Biswas (*A.M.*) (*to be published*)
(*Details to be announced later.*)

Tuesday, February 11, 1964, 9.00 a.m. to 1.00 p.m.

Civil Engineering Division—Symposium/Paper Meetings (4th Session)

(*Symposium continued from February 10, 1964*)

Paper Meetings (*continued from February 10, 1964*)

(22) 'Mechanization of Building Operations' by M. L. Jain (*M.*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

(23) 'Earthquake Resistant Design of Earth Dams' by Jai Krishna (*M.*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(24) 'Design of Column Foundation' by A. S. Kenkare (*Non-member*) (*Journal*, vol. 43, no. 5, pt. CI 3, January 1963)

(25) 'Testing of Clay Building Bricks' by D. Johnson Victor (*A.M.*) (*Journal*, vol. 44, no. 1, pt. CI 1, September 1963)

(26) 'A Series Solution for Beam Problems' by Dr. K. T. Sundara Raja Iyengar (*A.M.*) and S. Anantharamu (*Non-member*) (*Journal*, vol. 44, no. 5, pt. CI 3, January 1964)

(27) 'Ultimate Torsional Strength of Concrete Sections' by G. S. Pandit (*Non-member*) (*Journal*, vol. 43, no. 7, pt. CI 4, March 1963)

Electrical Engineering Division (2nd Session)

(*continued from February 10, 1964*)

(6) 'Application of Monte Carlo Method for Analysis of D.C. Electric Network' by Dr. S. Das Gupta (*Non-member*) (*Journal*, vol. 43, no. 6, pt. EL 3, February 1963)

(7) 'Linear Graph Theory—a Growing Engineering Discipline' by P. S. Satsangi (*Non-member*) (*Journal*, vol. 43, no. 6, pt. EL 3, February 1963)

(8) 'Engineering Magnetohydrodynamics with Particular Reference to Energy Conversion' by P. S. Satsangi (*Non-member*) (*Journal*, vol. 43, no. 12, pt. EL 6, August 1963)

(9) 'Development of Single-Phase Induction Motor with Partially Open Cage Rotor' by Prof. M. V. Deshpande (*M.*) and B. G. Desai (*Non-member*) (*Journal*, vol. 44, no. 4, pt. EL 2, December 1963)

(10) 'Analytical Treatment of Simultaneous Faults in a Power System Using α, β, and 0 Components' by Prof. H. N. Ramachandra Rao (*M.*) and K. Parthasarathy (*Non-member*) (*Journal*, vol. 44, no. 4, pt. EL 2, December 1963)

(11) 'Some Experience in the Construction and Commissioning of Bradwell Nuclear Power Station in Great Britain' S. K. Biswas (*A.M.*) (*to be published*)

Chemical Engineering Division (2nd Session)

(continued from February 10, 1964)

Public Health Engineering Division (2nd Session)

(continued from February 10, 1964)

(5) 'Accelerated High Rate Sludge Digestion' by S. R. Kshirsagar (*A.M.*) (*Journal*, vol. 44, no. 2, pt. PH 1, October 1963)

(6) 'Town Planning—Public Health Aspects' by Dr. G. Ghosh (*Non-member*) (*to be published*)

(7) 'Cost of Providing Sewage Treatment Plants Using High Rate Trickling Filters' by M. L. Shah (*A.M.*) (*to be published*)

Industrial Engineering Group—Paper Meetings

(1) Address by Shri R. M. Patri (*M.*), *Chairman*

(2) 'Assessment and Control of Thermal Environments in Indian Factories—Practical Concepts and Field Studies' by N. L. Ramanathan (*Non-member*), M. S. Chakravarthy (*Non-member*) and R. N. Mukherjee (*Non-member*) (*Journal*, vol. 43, no. 12, pt. GE 3, August 1963)

(3) 'A Study of the Learning Curve Slopes for Different Industrial Operations' by S. K. Basu (*A.M.*) and S. Chowdhury (*Non-member*) (*to be published*)

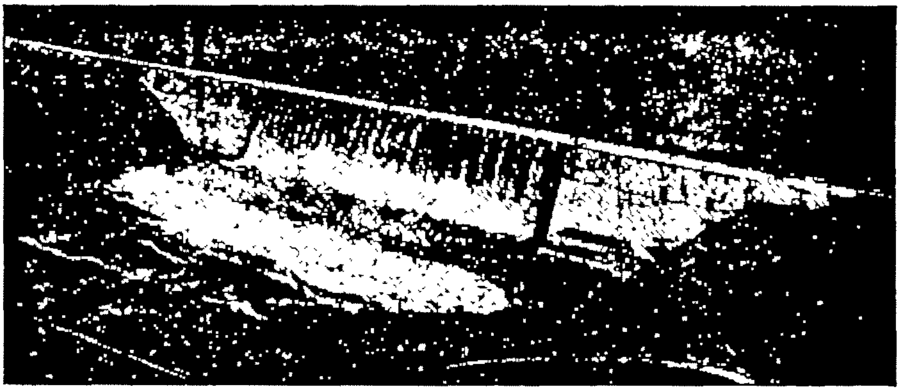
(4) 'Optimum Machine Allocation' by R. Mishra (*M.*), S. N. N. Pandit (*Non-member*) and S. C. Jain (*Non-member*) (*to be published*)

(5) 'Mathematical Programming in Production Control' by T. L. Subramaniam (*Non-member*) and C. A. Gilpin (*Non-member*) (*to be published*)

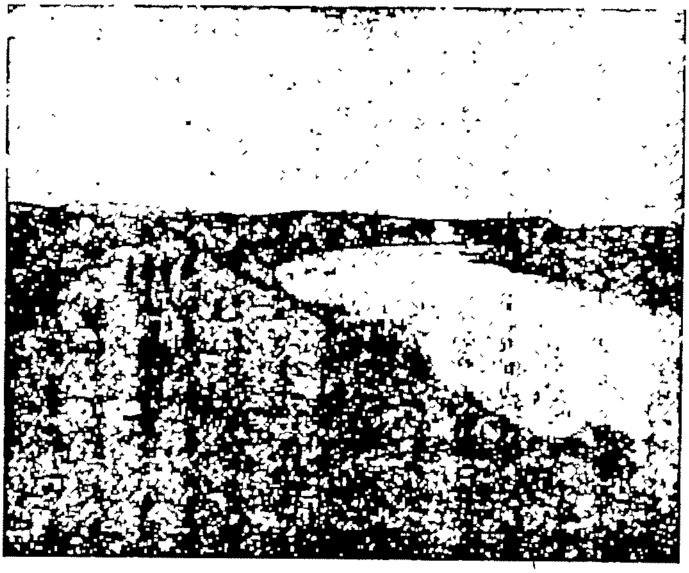
A VISIT TO NAGARJUNASAGAR AND NAGARJUNAKONDA

Nagarjunasagar project

This multipurpose undertaking in Andhra Pradesh envisages the building of a straight gravity masonry dam near Nandikonda village in Nalgonda District, situated 100 miles away from Hyderabad, across the waters of the mighty Krishna, and two canals one on each side of the river to give the benefit of irrigation to nearly 21 lakh acres of famine-stricken lands in the Krishna delta, including, additionally, stabilization for irrigation of over 3 lakh acres. The right bank canal runs to a length of nearly 135 miles and the left canal exceeds 108 miles.



Nagarjunasagar dam—an artist's view



A view of Nagarjunasagar right bank canal

One of the primary purposes of the project is obviously to meet progressively the rising demands of industry and the communities for more electrical power. With this in view, provision has been made for the generation of power in the final stage of the project. The mass of water will be conveyed through 14 ft. diameter penstock pipes. The walls of this large dam, the site of which, as any other similar project for the integrated development of resources, is today a conglomeration of giant machines to power and mountain heaps of raw-materials to feed its building, will stretch a man-made lake that will have a water spread of nearly 74 sq. miles and a storage of well over 54 lakh acre-ft.

A view of Nagarjunasagar left bank canal cut

The programme of construction is channelled in several stages, the entire scope of the scheme consisting of (i) construction of a high rubble masonry dam and an earthern dam on the flanks across the river, (ii) construction of the right and left canals, (iii) hydropower generation, and (iv) excavation of the valley of Nagarjunakonda for relics of past ages. This project is being executed by the Andhra Pradesh Government through the Nagarjunasagar Control Board. The project estimate is nearly Rs. 92 crores and the dam and the canals are expected to be completed in 1968-1969.

Glimpses of Nagarjunakonda

Rivers have always provided the rich and fertile regions for a perfect natural means of a comfortably easy existence and have thus been the moulding bases for many great civilizations that have flourished in the past and have disappeared, leaving behind in their trail many hidden treasures—the framework which has helped to enrich today's insights into the bewildering multiplicity of cultures and the variegated conglomeration of races and creeds that fashioned the story of these civilizations. The course of Indian history, similar to those of Egypt, Assyria and Babylonia, is strewn with examples of men—homeless nomads, intrepid buccaneers and insatiable invaders—who overwhelming nature's barriers, drained into the sunny realms of the mighty rivers—the Indus and the Ganges—one after another, to found, foster and spread some of the most ancient phases of human civilization. The attempt to delineate the story of the men who lived therein is no doubt a tale of woe. But the spirit to promote a cultural renaissance and so to inspire a yearning to unearth the ancient relics that link the men and cultures of past ages through modern scientific archæological excavations has, in a large measure, been responsible to give us the marvellous scenes of several ancient historic sites—such as Mohenjo-daro, Harappa and Taxila, Nalanda and Pataliputra, Mahasthan and Bangad, Sanchi and Saranath—one among them being Nagarjunakonda in the Guntur District of Andhra Pradesh, on the banks of the River Krishna, which is now known to have nurtured the Andhra civilization for over centuries.

We know that Buddhism, securing the imperial patronage of Asoka, became a world religion. Its influence embraced the great Kanishka into its fold. However, the tenets of Buddhism which Kanishka followed varied much from the simple ethical creed of the great Maurya. These newer doctrines of Buddhism came to be known as the *Mahayana* or the 'Great Vehicle', as distinct from the older school of thought that took the name *Hinayana* or the 'Little Vehicle'. The formulator of the *Mahayana* doctrines was Nagarjuna, a philosopher celebrity of the Satavahana period and a great Buddhist scholar from Ceylon. The Nagarjunakonda inscriptions make mention of fraternities of monks who were engaged in the great task of preaching and spreading Buddhism far and wide. Rightly enough, the great dam that is being built to mark an era of increasing benefits and prosperity to myriads of people has derived its name to recall to posterity the pious deeds of Nagarjuna.

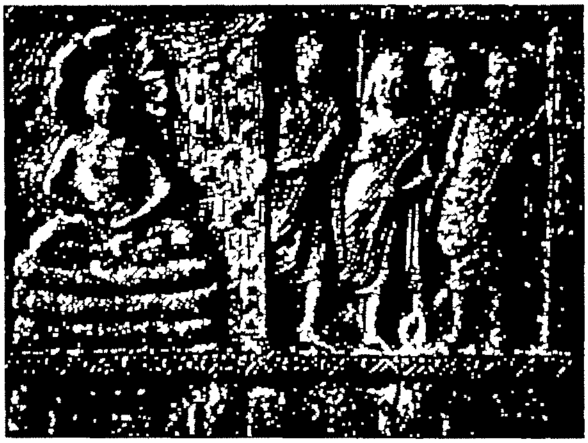
As Buddhism prospered, an enthusiastic community began to partake in building its monuments. The historical evolution of Indian sculpture, so closely knit with the several dynasties that led the Indian scene, and the cults that prevailed, falls into two distinct periods of study and two distinct themes, *viz.*, (i) mainly Buddhist, and (ii) partly Buddhist and partly Brahmanical. The pageant of life that pulsates at Nagarjunakonda concerns the influence of the Gandhara school and is largely Buddhist in its context, depicting the *Mahayana* phase of Buddhism.

Nagarjunakonda is situated to the north-east of Palnad Taluk in Guntur District. It is within easy access of Vijayapuri South Junction, which one traverses on the highway crossing the historic Palnad area from Hyderabad to Guntur. Well over 3,000 acres in extent, the valley is surrounded by precipitous hills that overlook the swift and mighty Krishna flowing from the west, thus offering an alluring spot for settlement, as also a means of defence and transport, and an infinite variety of natural inroads favourable for the foundation and sustenance of a distinct civilization.

Renunciation of Prince Sidhartha—a panel unearthed at Nagarjunakonda

A Mithuna couple—a panel unearthed at Nagarjunakonda

The illustrious Ikshvaku dynasty, famed in Vedic and epic tradition, it would appear, ruled for hundreds of years in the Krishna valley, which, it may not be incorrect to say, as seen from the recent excavations undertaken, is a fascinating treasure house of man's ancient cultures. Search has laid bare a continuity of cultures from prehistoric times ; however a major part of the buried material now unearthed has been identified to belong to the Ikshvaku period. Some of the finds include extensive remains of structures, both religious and secular, stretching along the river, stupas with inscriptions and *chaityas* which served as monastic units, a shrine related in its theme to Buddhism and devoted to the Buddhist patroness deity, Hariti, a vast stadium with an elaborate entrance, the remains of a palace that was once the home of royal pomp, relics of Hindu religious structures like sacrificial altars, bathing ghats and temples—all of which exemplify the cultural pursuits of life that fluorished in this ancient centre of Buddhist culture.



The Serpent-King protects the Buddha—a find at Nagarjunakonda

Danger now threatens obliteration of many of these masterpieces of art and architecture and antiquities of incalculable importance which may one day throw light on the origins of the predynastic cultures that may have prevailed in the valley. Archæological expeditions have been trying to locate more that may have been in existence and no effort is being saved to secure as much of the treasure before it gets immersed under the vast expanse of Nagarjunasagar.

Under the impact and influence of the great dynasties that reigned supreme in the Krishna valley, there came to be developed around Nagarjunakonda a culture in which a new awakening came into full flower. This culture still survives and is reminiscent in the precious relics that have come to light now. The forces of nature may have destroyed many of the other valuable evidences while man built over the land for centuries, but what remains is projected to be housed in the Nagarjuna Museum which will stand as a radiant peak soaring aloft in a lonely valley.

Other places of interest

Many are the buried complexes that have been excavated at Yeleswaram, once a flourishing city during the Ikshvaku period, and now a village on the River Krishna in the Devarakonda Taluk of Nalgonda District. The inscriptions discovered at Najarjunakonda indicate that the name Yeleswaram was probably derived from 'Elisiri', a respected commander-in-chief of one of the Ikshvaku rulers, to whom is attributed the construction of the temple of Yeleswaraswami. The Yeleswaraswami temple in the valley has been a centre of attraction for pilgrims from far-off places for centuries. The antiquities unearthed in this valley carry a history that is traced back to the Stone Age. This valley too will be submerged and will serve as one of the reservoirs when the Nagarjunasagar dam is completed.

Yet another ancient seat of Buddhist culture is Amaravati. The modern town of Amaravati is situated on the right bank of the Krishna River, about 18 miles from Guntur. It adjoins the ruins of Dhanyakataka, the ancient capital of the Andhras under Satavahanas, and the main centre of Mahayana Buddhism in the south. The sculptural relics at the Amaravati site is marked by a striking difference in style from those elsewhere, have a distinct charm of their own and have been rightly classified under a new school by, themselves. The Buddha image stands here as a symbol only and possibly points out the transition between Bodh-Gaya and Sanchi on the one side and Mathura and Gandhara on the other.

THE DECCAN SCENE

Founding of Hyderabad

The Deccan unfolds a history that is largely a portrayal of internecine struggles. Historical findings indicate that the Mauryan Empire had a sway over the Deccan before the reign of Emperor Asoka. After Asoka, his empire split into the eastern region which annexed into its folds the areas in the State of Hyderabad, and the southern region which fell to the powerful and rising Andhras whose rule and influence over the Deccan extended for over four centuries. The Chalukyas and Rashtrakutas dominated the scene later for nearly 600 years. Ultimately, under the stress of the Yadavas and Hoysalas, the Chalukyas who had regained power from the last of the Rashtrakuta kings lost their hold and prestige in the Deccan. Within countable years, though Sultan Muhammad Ghori could not effect serious changes in the Deccan by his invasion, the Yadavas and Hoysalas were completely overthrown by Ala-ud-din Khalji who marched south in 1294. The next picture is that of Sultan Muhammad bin Tughalak whose disorderly methods became responsible for the breaking of his territories. A part of the Deccan fell under the occupation of the Bahmani dynasty, but by the middle of the 15th century, involved in war, they began to subjugate and the kingdom separated into independent units. Towards the close of the 16th century, the Mughals began their assault and annihilate the then ruling dynasties of the Deccan, so gaining a secure place in its history, which witnessed the ambitious campaigns and conquests of

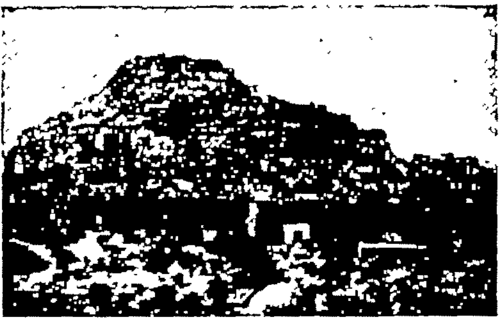
Shah Jahan and Aurangzeb up to 1707. Things were however not quiet in the Deccan in the meantime. The Sayyid brothers or the 'king-makers' as known in Indian history, had raised to power as emperor Muhammad Farrukh-Siyar in 1712, with the alliance of Chin Qilich, the able man of the Turani group. Chin Qilich, now honoured with the title Nizam-ul-Mulk, was given the viceroyalty of the Deccan but was soon ousted from this position. However, on the death of Farrukh Siyar, Muhammad Shah succeeded to the throne and Nizam-ul-Mulk was restored as Viceroy of the Deccan but not without misgivings. Undeterred by Muhammad Shah's sinister moves, after a victorious campaign against Mubariz Khan, one of Muhammad Shah's deputies, Nizam-ul-Mulk established his rule, with Hyderabad as capital in 1725, thus forcing Muhammad Shah to recognize his status and confer on him the title of Asaf Jah. This event marks the foundation of the former State of Hyderabad. Situated on the right bank of the River Musi, the city of Hyderabad was founded by the name 'Bhagnagar' (after his favourite mistress Bhagmati) by Sultan Mohamad Kuli Kutb Shah, the fifth king of Golconda, nearly 374 years ago. The city acquired its present name after one of the titles of Nizam Ali.

Art and architecture of the Deccan

Although this is a chronological narration of the many events that symbolize the peaceful and prosperous as well as the restless and ravished periods in the romantic history of the Deccan, behind it lies hidden the story of the unsurpassed dedication of many men—rulers and generous patrons—creative inventors, who not only sprung into life new creations in art, sculpture and architecture but have left to us, in the expanse of time, unerring expressions of the intellectual might and the magic hands of their times that strived to blend aesthetic elements and architectural forms that dominate majestically even to this day, with a grandeur, grace and elegance of their own. Thanks to archæological research, the veil of obscurity is uncovered giving us a glimpse of the many extensive ruins that were once the matrix of civilization. Here we witness in vivid colours a whole age come into life. It is a grandiose landscape that enshrines the noble monuments of man's artistic achievements—in stone and a superb variety of other building materials, which nature has favoured in bounty in the southern parts of the country.

The architectural works of the Deccan can be broadly classified under the heads: early Hindu monuments, rock-hewn architecture, Muslim monuments, forts, and recent works; some of ancient ones are extant and in good preservation and stand in vivid contrast with each other, revealing a vitality that bewilders the visitor. Each work exhibits a distinct characteristic and style.

The archæological heritage of the former State of Hyderabad includes palaeolithic, neolithic and other prehistoric remains—the ruins are numerous, varied and scattered. Facades with elaborate entablature, carvings that are elegant and vivacious, pillars with preponderant ornamental designs disposed in complicated patterns, giant gateways and pillored colonnades, soaring shrines and massive mosques, spectacular domes and noble tombs, rock-hewn monastries and structural *chaityas*, stupas surmounted by honorific umbrellas and porticos of exquisite design, dilapidated palaces and once impregnable forts, not to mention the other profuse embellishment of artistic devices, are some of the relics of Indo-Muslim art that leave an unforgettable impression of the majesty and solemnity that was of an earlier age. The Asokan rock edicts of Maski and Kadkal, the antiquities at Kondapur, the thousand-pillared temple and the gateway at Warrangal, the temples at Ittagi and Palampet, the *chaitya* at Ter, the ruins of ancient Paithan, the historical relics of Amba Jogi (now called Mominabad), the Maruti Gudi at Nagai, the shrines of Shiva and Vishnu at Garla near Dornakal junction, the famous temples of Hanumakonda, and of Jagannatha at Aundha, the enchanting caves and frescoes and the spacious shrines and monastries amidst the romantic surroundings of Ajanta and Ellora, the works of Muslim builders such as the Gol Gumbaz and Jama Masjid at Bijapur, the royal tombs and battered forts of legendary Golconda, the Langerki-Masjid and the fort of Gulbarga, the great mosque and the forts of Bidar and the Bibi-ka Maqbara, the tomb of Aurangzeb's wife modelled to rival the Taj Mahal, at Aurangabad, the historic fort of Daulatabad, the ruins of the great Vijayanagar Empire at Hampi, are some of these that come to mind foremost, constraining over attention within and in the near reaches of Andhra Pradesh. Of engineering interest is the Tungabhadra dam close to Hampi.

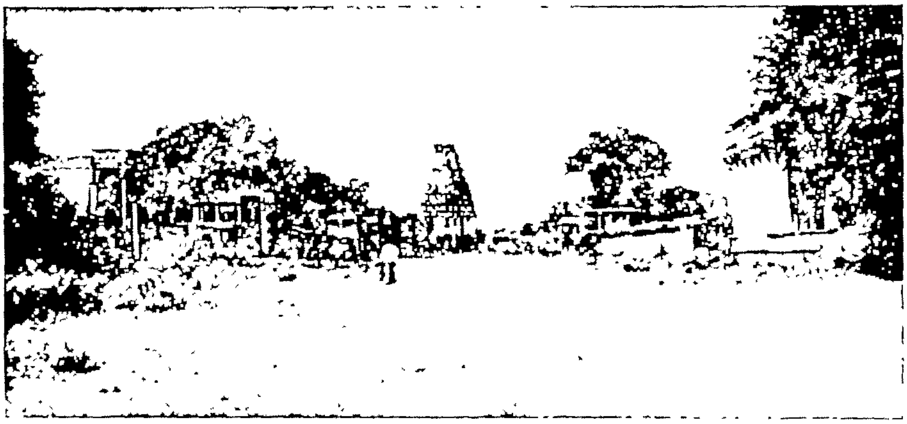


Fort of Daulatabad

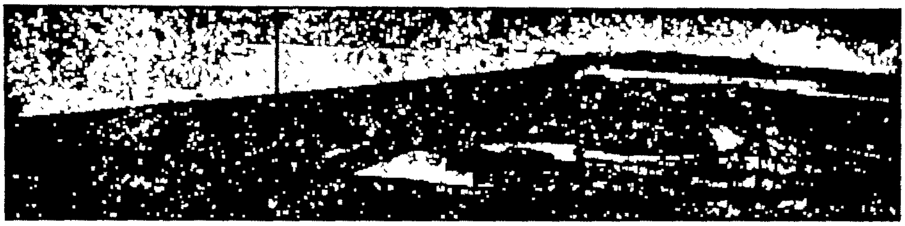
Interior view of a cave in Aurangabad

In order to visualize the growth of the various styles that have marked the masterly sculptures and the monumental grandeur we witness today, of necessity, we have to trace back a space-time continuum representing each period in Indian history. Obviously, this is a task well beyond the confines of these pages. Possibly the few illustrations given here would reflect the features better.

Lotus Palace, Hampi



Ruins of famous temples and palaces, Hampi



A view of Tungabhadra dam

HYDERABAD AND ITS ENVIRONS

The city of Hyderabad, the capital of Andhra Pradesh, is situated on the southern bank of the River Musi. The Wadi-Vijayawada line connects it with the Madras-Delhi, Madras-Calcutta and Madras-Bombay main lines. The city is surrounded by a stone wall, crenellated like a battlement, probably commenced by Mubariz Khan and completed by the Nizam-ul-Mulk, and is trapezoidal in shape. It is linked on the air-routes to Madras, Bombay, Bangalore, Delhi, Aurangabad and Visakhapatnam.

Well laid out and stretched by wide roads and avenues, the city bus service of the Andhra Pradesh State Road Transport Corporation, Gowliguda, Hyderabad (*Telephone* 5158) serves all the important locations in the city. Bus arrangements to facilitate sight-seeing tours for groups of visitors are also made available to Osmanasagar (Gandipet), Himayatsagar, Golconda, etc. The Hyderabad Private Bus Owners' Union, Afzalgunj, Hyderabad (*Telephone* 5860) also operates similar services.

The State Tourist Information Bureau is situated on Mukramjahi Road, near the railway station and opposite Gandhi Bhavan (*Telephone* 5216/5058). Hyderabad has also a State Information Centre at the same address as above, the State Central Library at Afzal Gunj, the United States Information Services on Mukramjahi Road and a Press Information Bureau of the Government of India (*Telephone* 34725). The Tourist Department conducts city tours on Sundays, Tuesdays and Thursdays to such places as the Public Gardens, Golconda tombs and forts, Osmansagar, Salar Jang Museum, Char Minar, Mecca Masjid, Osmania University, etc. Trained guides to accompany visitors are also available. Several places of tourist interest are linked by good motorable roads from Hyderabad. These include Aurangabad (348 miles), Nagarjunasagar (104 miles), Nizamsagar (95 miles), Tirupati (446 miles) and Warangal (97 miles). The State Transport also provides regular bus facilities to all the District Headquarters of the State and the tourist sights. Other transport facilities include taxis and auto and cycle richshaws.

Some of the places for recreation in and around the city are : the Public Gardens and the Zoo in Saifabad; the Hanging Gradens in Red Hills; and the Municipal Parks on Club Road, Secunderabad, and on the northern bank of the river at Afzal Gunj. Boating is another attraction at the Public Gardens and Husain Sagar. To the cinegoer, some of the important picture houses in the city that come in handy are the Plaza, Rivoli and Dreamland (in Secunderabad) and the Embassy and Lighthouse in Hyderabad. Among the Western and Indian style restaurants and bars are the Kwality, Savoy Hotel and the Taj Mahal; besides these, there are one or two Chinese restaurants also.

A visit to Hyderabad would be incomplete unless one obtains an impression of the attainments and heritages of the several dynasties that ruled in the past through the treasures that are contained in the Salar Jung Museum, the Government Archæological Museum, the Ajanta Pavilion and the Yeleswaram Museum. Hyderabad offers a variety of attractions to the purchasing visitor. Kondapalli toys (lacquer painted wooden toys, depicting more than what a toy can really mean). Nirmal Plates, Bidri ware, crochet work and exquisite inlaid ivory and wood-work are some of the handicraft goods that are available at the Government of Andhra Pradesh Handicrafts and Industries Emporium, Gunfoundry, Hyderabad (*Telephone* 35023) and the Gandhi Gramudyog at Sultan Bazar. Abid Road and Pathergatti in Hyderabad and Mahatma Gandhi Road and Rashtapati Road in Secunderabad are the principal centres for shopping. The General Post Office is also situated on Abid Road. Hyderabad maintains manufacture of well known textile fabrics, carpets and silk.

Along its periphery, the city has a number of gateways : Chadargat, Delhi or Afzal Gunj, Char Mahal, Old Bridge (*Purana Pul*), and Dudh Baoli Gates, Fateh Darwaza, Aliabad Gate, Lal Darwaza, Ganlipura Gate, Mir Jumla, and Yakutpura and Dabirpura Gates. The Musi River has four crossings on the northern side, the bridges erected being the Oliphant bridge on the east, the Afzal Gunj bridge on the west, the Mussallan bridge and the Old Bridge (*Purana Pul*). The High Court is situated near the Afzal Gunj bridge and in the vicinity are the River Gardens and the Osmania General Hospital. Next to the hospital stands the Afzal Gunj Masjid with four lofty minarets. Among the several congregational mosques built by the rulers for family worship, the Toli mosque, the Kutb Shahi mosque and the mosque of Mian Mishk are the more important ones.

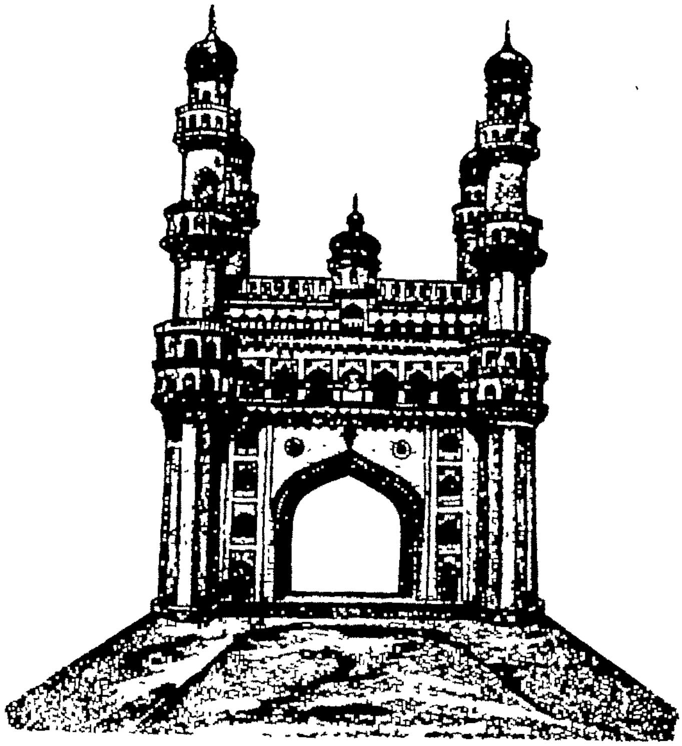
The city, though gradually getting industrialized, has in many ways maintained the quietitude and dignity as the capital of the former Nizam State. It retains an old-world spaciousness alongside the phases of modern life and is certainly a city of glaring contrasts with the turn-of-the-century buildings of concrete and agglomerations of others that have not undergone positive modifications. The wide avenues and the attractive river front with promenades and gardens will remain in the memory of every visitor. Sultan Kuli's (founder of the city) attempts to enlarge and embellish the city has to-day preserved to us several noble and picturesque works that bear witness to the genuine love and artistic talent for architectural styles of the great builders of the Kutb Shahi dynasty. In here we see a city that has come to be created by Hindus and Muslims with a sophistication and tenderness all its own, reflected in the imposing landmarks and the magnificent historical monuments and edifies that are liberally strewn in and around the city, which few other cities can boast of.

A view of Osmansagar on River Musi

A view of River Musi through Hyderabad city showing Osmania Hospital on the right and Andhra Pradesh High Court on the left

To recount some of the most notable, we have the Char Minar, the Mecca Masjid, the Chaumahalla Palace, the Jama Masjid, the Mushirabad mosque and the Jahannuma among the old, and the university buildings, the High Court, the Osmania General Hospital among the new styles. Brief descriptions only are given here of these.

The Char Minar, the most symbolic structure of the Kutb Shahi period, has an elegance that is unrivalled by any other monument of similar construction of stone and mortar. As the legend goes, the Char Minar was built to ward off the plague that took the city by storm in an epidemic form. It is said to resemble the tomb of Imam Husain and was built in 1591. Half-a-mile away from the Afzal gate is situated this stately rectangular building, with four minaretes—slender and graceful—each nearly 185 ft. high. With four roads radiating from it, it looks a sentinel stretching protection to the entire city.



Char Minar, Hyderabad

The Mecca Masjid is the principal congregational mosque in the city, on the western side of Char Minar. This is an impressive and imposing edifice and can accommodate well over 10,000 worshippers. Its construction was started by Sultan Kutb Shah and completed by Emperor Aurangzeb.

Next comes the great Jama Masjid built in 1598 A.D. with a sobriety that is verily characterized in the inscription in its gate that runs to say 'Paradise is come to stay in its courtyard'. This was erected by Sultan Muhammad Kuli and is the oldest in the city.

The university buildings are situated at Adikmet. They are beautiful and expensive, with a blend of architectural styles that has symbolized the oneness of men and minds whose sole aim was revive learning and art.

Near the Afzal gate, on the left, is the palace of the famous Sir Salar Jung. In the fine museum housed in this palace, there is a spectacular experience, a whole treasure-trove, in store for the art lover. The finest collection of works of art, the most precious jewellery, a vast array of curios from the world over, the rarest paintings, masterpieces of historical eminence, and a distinguished suit of armour and swords of Mughal kings contained here are the results of the individual enterprise of Mir Yusuf Ali Khan Salar Jung III, a late Prime Minister of the State and a great connoisseur of art. Tradition and cultural heritage, historic forms and fascinating colours—these are the things portrayed in the wealth enlivened here, which has been a magic attraction to beholders from far and near.

The Archeological Museum has a fine collection of exquisitely carved panels decorative carvings and floral decorations, and other antiquities of archeological and architectural interest from Paithan (the ancient capital of the Andhras) and Celadon, that are inseparably bound up with the early history of the Deccan.

The Falaknuma Palace, built as a private residence by the late Nawab Sir Vikar-ul-Umra and purchased by the Nizam, is one of the most attractive structures that overlooks from an eminence in the south-west of the city. With a luxuriant profusion of green and flowering landscape surrounding it, the architect has created a magnificent spectacle here, with decorations that are artistic and outstanding.

The Nampalli Public Gardens is a show of rare plants from many lands set amidst two ponds and is one of the best laid-out gardens in the country. The Archeological Museum, the Town Hall, the Ajanta Pavilion, the Health Museum, etc. are situated in its boundary.

The *Naubat Pahar* or the rock from where, it is said, the communications of the rulers were proclaimed by drum beats affords a beautiful scene.

The King Kothi, the Chaumahalla Palace to the south of Char Minar and the Jahannuma outside the Alibad Gate are other monuments worthy of a sure visit.

The tomb of Raymond, a French soldier in the services of the then Nizam, is nearly two miles from the Oliphant bridge. Raymond was such a favourite among men that a large *Urs* or fair was being held and his tomb illuminated on the anniversary of his death.

The King's tombs or the tombs of Kutb Shahi kings are reached from the legendary forts of Golconda. Gracefully built, the finest tomb is that of Muhammad Kuli Kutb Shah, the founder of the city of Hyderabad.

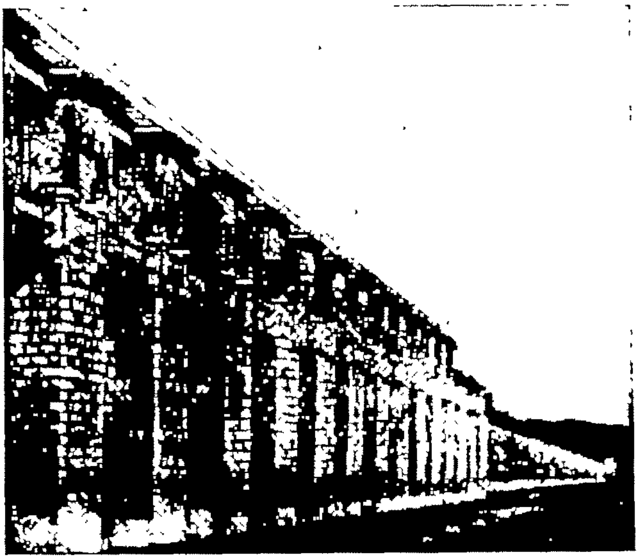
September 28, 1908, was a day of terrible disaster in the history of Hyderabad. Many other news faded into the background as the devastating deluge, caused by the Rivers Musi and Easi overflowing their banks and leaving behind a dismal trail of death and destruction, literally swept its way into the limelight. After investigating the engineering aspects of the problems, a scheme, meant for the reconstruction of the city and flood protection to the city, as well as a modern underground drainage system, proposed two storage reservoirs, one across each river.. Upstream is the Osman Sagar at Gandipet and two miles from here is the Himayatsagar. Both provide excellent picnic spots.

Thus the contrasts which for centuries have determined the character of Hyderabad are apparent. The spell of the ancient and the proximity and influence of the modern characterize the silhoutte of this city, which, like other ancient cities, has a fabled antiquity. The tourist, as he strolls through, will discover something unusual and something fascinating at every turn, feeling and absorbing the colour of its environs, in the thronged bazaars and the wide avenues alike. Today as the capital of a State and with its large university, its fine edifices and its illustrious past, it remains the largest town and the centre of cultural life of the State.

To the visitor fond of travel, recreation, edification or entertainment, or, impelled by the call of faraway places by curiosity, by thirst for knowledge, by boredom or by a variety of other motives, there are many other attractions around. Organized tourism is now an industry with specialized personnel, trained couriers and attractive advertising. Travel once a momentous and perhaps unique occurrence in a person's life is today a matter of course.

Flood gates of Osmansagar

A view of Himayatsagar on River Easi, Hyderabad



Flood gates of Himayatsagar

Please tear off here and send the Form early to the Secretary at the Headquarters Office in Calcutta to ensure its quick return to you.

THE INSTITUTION OF ENGINEERS (INDIA)

8, Gokhale Road, Calcutta-20

Subject : Rail concession to delegates attending the 44th Annual General Meeting at Hyderabad in February 1964

Railway Board Ref.: TC-II/2135/63/1 dated New Delhi, November 26, 1963.

Certificate Form

It is certified that Shri/Shrimati........................is a person travelling from........................to..............to attend the 44th Annual General Meeting to be held at Hyderabad from February 8 to 13, 1964, and is entitled to the concession of return tickets in any class available for one month as indicated below :

Class	On payment of
First class return tickets	Single first class fares
Second class return tickets	Single second class mail fares
Third class return tickets	Single third class mail fares

(i) He/She is a servant of the Central/State Government/local body or a Statutory authority.

(ii) He/She is not a servant of the Central/State Government/local body or a Statutory authority.

(iii) His/Her travelling expenses will not be borne by the Central/State Government/local body or a Statutory authority.

Place ....

Secretary

Date ....

OFFICE STAMP OF THE INSTITUTION

† I hereby certify that I am an employee of the Central/State Government/local body or a Statutory authority and that I shall not claim mileage allowance from the Central/State Government/local body or Statutory authority for the journey performed on the concessional return ticket.

Signature.................................

Place .... Designation..............................

Date .... Office address..........................

† *Note* : 1. This certificate must invariably be filled in by employees of Central/State Government/local body or a Statutory authority.

2. Government servants, etc. whose travelling expenses are borne by the Central/State Government or a local body or a Statutory authority either wholly or even partly are not entitled to this concession. Any breach of this rule by the Government servant will render him liable to disciplinary action.

Keep this with you till after the Annual General Meeting, and then return it to the Headquarters.

I availed of the rail concession given by the Railway Board for members of Institution attending its Annual General Meetings, and travelled on this concession from........................to Hyderabad and back from Hyderabad to....................................

Name of delegate...

Signature.. .. . .

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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A LETTER FROM THE PRESIDENT TO THE MEMBERSHIP

Dear Friend,

When I assumed the high office of President of this Institution in May this year, three matters had been in the forefront of my thoughts with regard to the Institution. I took the opportunity of a meeting of the Council soon thereafter to speak to members of the Council about them. These suggestions, which I give in outline in this letter, received the approbation of the Council.

The first of these was in regard to the considerable difficulty which Students of the Institution experience in preparing themselves for the Institution examinations. These examinations are acknowledged to be of very high standard. Our Students manage, very commendably, to arrange for their practical training in one form or the other in departments of Government, factories or workshops. But their theoretical and laboratory preparation is often inadequate.

I had been thinking for some considerable time if facilities could not be extended to our Students in the engineering colleges and in the polytechnics by the conduct of part-time courses in those institutions. I had had discussions with the Ministry of Scientific Research and Cultural Affairs, Government of India, on the subject. I was happily able to tell the Council that the Ministry was recommending, as one of two measures for the increased output of technical manpower at degree level, that engineering institutions might provide facilities for part-time courses for the benefit of Students of professional bodies such as ours. I also told the Council that the Ministry had made this recommendation to all State Governments and to all universities and engineering institutions conducting degree courses.

I, therefore, thought it might be feasible for each of our Local Centres to follow this matter up with the engineering colleges and polytechnics in their respective areas, and examine if it would be possible for their Corporate Members to take part in the teaching programme. I had an assurance that if such a project took definite shape, the Ministry of Scientific Research and Cultural Affairs would give financial assistance.

The second focus of my thoughts was the establishment of book banks at engineering colleges under the sponsorship of the Local Centres. For this purpose, I had suggested that each Local Centre might select one or two engineering colleges from its area. The general idea was that if the college would agree to set apart Rs. 1,000 for the establishment of a book bank, the Institution would provide a matching grant of double this amount, that is, Rs. 2,000. Books could then be purchased for the total amount of Rs. 3,000 and housed in the colleges in bookshelves which would also be furnished by the Institution and carry its name. I felt that through this means Students of the engineering colleges would begin to develop a feeling of oneship with the Institution, a feeling which is noticeably, and regrettably, absent today. It is my belief that it is very necessary that these students become Students of the Institution, and thus associate themselves with us right from the beginning of their professional careers.

The last and the third point which I commended to the Council was the institution of refresher courses for practising engineers and the holding of seminars on selected subjects at least once a year in each of the Local Centres. I thought I would be correct in assuming that practising engineers would welcome refresher courses, as, where such courses are available, there is generally great enthusiasm from the engineers working in the field to enrol themselves. Therefore, if the Institution does, through its Local Centres, provide this opportunity, it would be doing an important service.

On the question of seminars, although Local Centres have held these now and again, I felt it would be desirable to make them permanent features in the technical activities of the Local Centres, so that at least one seminar on a subject of current engineering interest is carefully selected, planned and held at each Local Centre during a year. The proceedings of these seminars would then be edited and published, and would form a useful source of reference for all our members.

After the Council approved of these proposals, on 5th June, 1963, I addressed a letter to the Chairmen and the Honorary Secretaries of all the Local Centres and also to all members of the Council requesting their assistance in their implementation. A certain amount of progress has been made at some of the Local Centres.

My year of office as President is coming to an end. I would, therefore, very much like to take stock of what has been achieved in respect of the above matters, more particularly as I had initiated them. I am now in the process of asking myself what part of the above programme has been accomplished? If the results have not been all that could have been desired, what have been the reasons for this lack of achievement? Is it because that I have not been able to arouse enough enthusiasm for any or all these subjects?

I am, therefore, addressing this letter personally to you in the hope that you will let me know what part you have played in their implementation, the primary object of which has been to revitalize the activities of this Institution *vis-à-vis* the profession and enthuse the aspirants to the profession. I would appreciate it very much if you would write to the Secretary and let him know something about the part you have played, or, if there have been any impediments in playing your part, what these impediments are?

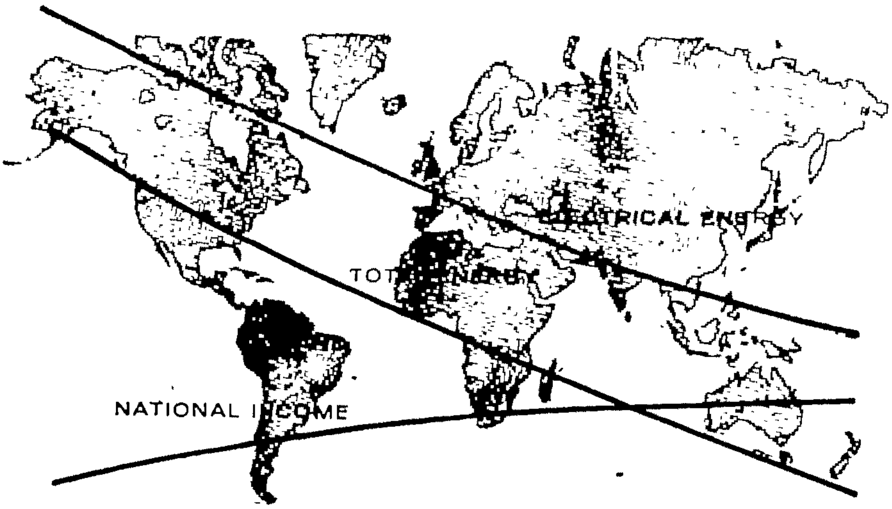
Yours sincerely,

(Dr. T. Sen)
President

ELECTRICAL ENERGY, TOTAL ENERGY AND NATIONAL INCOME —THEIR GROWTH AND INTERRELATIONSHIP THROUGHOUT THE WORLD FROM 1955 TO 1960*

Fremont Felix
Non-member
European Representative, Stone & Webster Engineering Corporation,
Boston, Massachusetts

Presented at the I. E. E. E. 1963 Summer General Meeting, Toronto, Ontario, June 16-21, 1963



by Fremont Felix, European Representative, Stone & Webster Engineering Corporation, Boston, Mass.

Title design

The correlation between 'National Income and Electrical Energy' was covered by the author, for the first time in a paper[1] submitted at the AIEE Summer General Meeting of June 27-July 1, 1955.

The obvious shortcoming inherent in an analysis based on only one of the several forms of energy which participate in the economic life of a country and which contribute to the generation of its national wealth suggested the undertaking of a similar study, this time on the basis of total energy.

The prompt availability of the United Nations 'World Energy Supplies' statistical papers,[2,3] without which this study could never have been undertaken, makes it possible to present, now, a comprehensive analysis for the 1955-60 five-year span.

Energy equivalences

In integrating all forms of energy in order to arrive at the total, calculated in 'equivalent' kg of coal, the coefficients of equivalence used in the United Nations studies[2,3] have been retained, except for 'hydro-electric and imported electricity,' for which, in order to compare all sources on the basis of the heat energy that could be produced under ideal conditions, the United Nations statistical papers[2,3] evaluate 1kWh as equivalent to 0.125 kg of coal.

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* Conference paper no. CP 63-967 sponsored by the Power System Engineering Committee for presentation at the IEEE Summer General Meeting, Toronto, June 16-21, 1963.

The Robinson report[4] evaluates hydro-electric power on the basis of the amount of coal which would have been required in modern coal-fired power stations to generate the same amount of electricity, on the basis of 2,800 kilocal. per kWh (11,100 B.Th.U. per kWh) which means translating 1 kWh as 0.4 kg of coal equivalent.

In the preparation of this study, and in order to simplify the task of converting the large number of equivalent energy country totals for hydro and imported electricity extracted from the United Nations papers where they are entered on the basis of 0.125 kec per kWh to values approximately corresponding to the 0.4 kec per kWh basis of the Robinson report,[4] the United Nations totals for hydro-electrcity were multiplied by 3, which means translating 1 kWh as 0.375 kec corresponding to a plant efficiency of 2,625 kilocal per kWh or 10,400 B.Th.U. per kWh.

All these coefficients of equivalence and the corresponding energy contents are tabulated in Appendix 1.

Statistical tabulation

The statistical tabulation, given in Table 1, which provides a summary for the world as a whole, and for the 10 geographic areas in which its population has been divided, shows the contributions of each of the four primary sources of energy to the total. It also shows the use of electrical energy and its annual rate of growth, as well as that of each of the four primary sources.

Appendix 2 lists comments intended to facilitate the understanding of each of the columns, numbered I through XV, of Table 1.

Analysis of country data

The same statistical data, shown for the 10 geographic areas tabulated, have been separately calculated for 85 individual countries and these plus the national income data available for many of these 85 countries, have been plotted in Figs. 1 through 6.

It will be noted that all country points, each plotted at the ape of a 90° angle, have been identified by the capital letter of the geographic group to which they belong, as listed in the statistical tabulation.

Geographic area average points are similarly plotted, and these can be identified by the small arc drawn from the apex of the 90° angle.

'Average' curves have been drawn on the basis of all these plotted points, and the degree of exactness of this average plotting has been verified by cross-checking against one another the independently drawn, yet interrelated, averages. This is explained later in connection with Fig. 7, which recapitulates all average curves arrived at in Figs. 2 through 6.

STATISTICAL TABULATION BY GEOGRAPHIC AREAS		1960 POPULATION 10^6	1960 CONSUMPTION OF ENERGY							1960 CONSUMPTION OF ELECTRICITY		1950-1960 ANNUAL RATE OF INCREASE OF CONSUMPTION					
			PER CAPITA		AGGREGATE 10^6 KEC												
			TOTAL ENERGY		HYDRO ELEC'Y	SOLID FUELS	LIQUID FUELS	NATURAL GAS	TOTAL ENERGY	PER CAP KW. HRS.	AGGREG. 10^9 KW. HRS.	ELEC-TRIC'Y	HYDRO ELEC'Y	SOLID FUELS	LIQUID FUELS	NATURAL GAS	TOTAL ENERGY
		I	II		III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
CARIBBEAN AMERICA	A	67	815		3.8 4.80%	4.67 -5.80%	53.21 66.00%	18.64 23.30%	80	330	25.74	11.8%	10.2% 0.47	6.0% 0.41	6.30% 4.30	18.8% 3.94	8.7%
SOUTH AMERICA OTHER THAN CARIBBEAN	B	128	525		9.3 13.80%	7.08 10.50%	47.5 70.30%	3.6 5.40%	67.5	334	42.65	9.7%	10.9% 1.28	-0.9% -0.06	5.7% 3.90	16.9% 0.60	5.0%
EUROPEAN-COMMON MARKET SCANDINAVIAN COUNTRIES & UK WESTERN EUROPE OTHER THAN C,D,E	C D,E F	167 73 84	2,790) 4,515) 1,180)	Eu 2,790	84 9.40%	541 60.55%	253 28.35%	15 1.70%	893	1,800	586.00	7.7%	7.0% 0.80	-1.0% -0.70	13.9% 2.90	16.9% 0.20	3.0%***
COMECON COUNTRIES IN EUROPE*	G,H	300	2,875		21.51 2.30%	651.27 70.70%	173.50 18.80%	75.53 8.20%	921.8	1,320	402.62	10.8%	15.8% 0.30	3.9% 2.72	11.3% 1.82	20.3% 1.90	6.9%
OIL-PROD COUNTRIES MIDDLE EAST OTHER COUNTRIES IN THE MIDDLE EAST	I J	90 100	300) 210)	ME 205	0.63 1.70%	4.72 12.60%	30.02 82.00%	1.90 3.70%	37.3	63	11.68	12.0%	47.0% 0.30	1.01% 0.14	14.7% 8.20	12.8% 8.88	10.7%
NORTH AFRICA CENTRAL, SOUTHCENTRAL & S.AFRICA	K L,M	27 164	226) 390)	AF/ 320	2.67 4.40%	43.08 70.40%	15.35 25.08%	0.04 0.07%	61	193	36.75	9.3%	17.9% 0.55	2.6% 1.83	6.0% 1.41	31.0% 0.01	3.0%
SOUTH WESTERN & S.CENTRAL ASIA SOUTHEAST ASIA FAR EAST ASIA & JAPAN	N O P,Q	592 180 180	125) 115) 780)	AS 205	27 11.60%	125.0 54.40%	73.30 31.60%	5.60 2.40%	231.6	170	148.61	12.1%	8.2% 0.66	6.8% 3.80	14.0% 3.85	10.7% 0.29	6.6%
COMECON COUNTRIES IN ASIA**	R	747	605		7.23 1.60%	431.62 95.6%	12.80 2.80%	0 0.00%	451.6	86	65.44	22.2%	28.0% 0.50	21.9% 32.80	30.3% 0.08	———	24.2%
AUSTRALIA & NEW ZEALAND	S	13	3,750		3.9 8.10%	28 58.10%	16.30 33.70%	0 0.00%	48.2	1,810	32.22	7.9%	7.08% 0.58	2.6% 1.00	3.08% 1.25	———	3.8%
CANADA & USA	T	198	8,150		96 5.90%	376 23.30%	643 39.80%	498 30.80%	1,613	4,880	967.54	6.2%	6.0% 0.33	-2.8% -0.78	3.0% 1.20	7.0% 1.98	2.7%
WORLD	W	3,015	1,465		258 5.85%	2,213 50.20%	1,318 29.90%	616 14.05%	4,408	765	2,296.08	8.3%	7.9% 0.44	4.0% 2.10	6.8% 1.98	9.3% 1.18	5.7%

*BULGARIA, CZECHOSLOVAKIA, EAST GERMANY, HUNGARY, POLAND, ROMANIA & USSR **CHINA MAINLAND, NORTH KOREA, NORTH VIET-NAM, MONGOLIAN PEOPLE R.

***EUROPEAN COMMON MARKET COUNTRIES 4.3% ALL OTHER COUNTRIES IN WESTERN EUROPE 1.7%

Table 1

Since all country data are plotted against total energy per capita,* the reader interested in any one country can ascertain from Table 1 the average consumption of total energy per capita for this country's geographic group, and by referring to Figs. 1 through 6, appraise the 'dispersion' range spanned by countries within this group.

It is the purpose of this paper to focus attention on near-term and long-range rates of growth rather than on statistical data which are readily available for any country and from this standpoint, the study of the averages should prove most meaningful.

Ratio of total energy to national income†—1960

The greater degree of monetary stabilization achieved throughout the world in recent years has permitted incorporating, in Fig. 1, a very large number of country points. The fairly close configuration within which these points align themselves

The author has specially prepared for publication in the *Bulletin* the following data which applies to the 1956-61 five year span, as it is felt that this specific information as to the growth of energy in India may be of interest to members.

In India in 1961, the consumption per capita was :

for total energy	.. 155.6 kec
for electricity	.. 51 kWh

Thus the share of the consumption of electricity in the consumption of total energy was 13.1% which, as can be seen from Fig. 2, is close to the world's average for India's present state of industrialization.

In 1961, of the total consumption of energy for India 68,86,00,00,000 kec., hydro-electricity represented 5.3%, solid fuels 80.3%, and liquid fuels 14.4%.

During the period 1956-61, India achieved the following growth of consumption on an annual compounded basis.

Total energy	.. 7.8%
Electrical energy	.. 13.5%
Hydro-electricity	.. 16.5%
Solid fuels	.. 7.3%
Liquid fuels	.. 7.3%

During the same period the increase of the population was 2.2% per year.

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* In cases where it is more convenient to refer to kWh instead of kec per capita, the reader can find in col. VIII the kWh per capita for the geographic area in which he is interested and then, by referring to col. II, obtain, as the ratio : $\frac{\text{Col. II}}{\text{Col. VIII}}$, an approximate multiplier from kWh to kec. For the world as a whole, this multiplier would be 1.93, and 2 may will be used as an initial approximation permitting a very preliminary use of the abscissae scale in Figs. 1 through 7.

† Gross national product (G.N.P.) which is often mentioned in a related connotation with national income, exceeds national income by the sum of indirect business taxes (sales, excise and property) and fixed capital consumption (including installation of complete plants and equipment, as also major repairs and maintenance which prolong the normal period of utilization of the plant or equipment and increase its value).

gives added weight to the interrelationship between the generation of national income and the consumption of total energy.

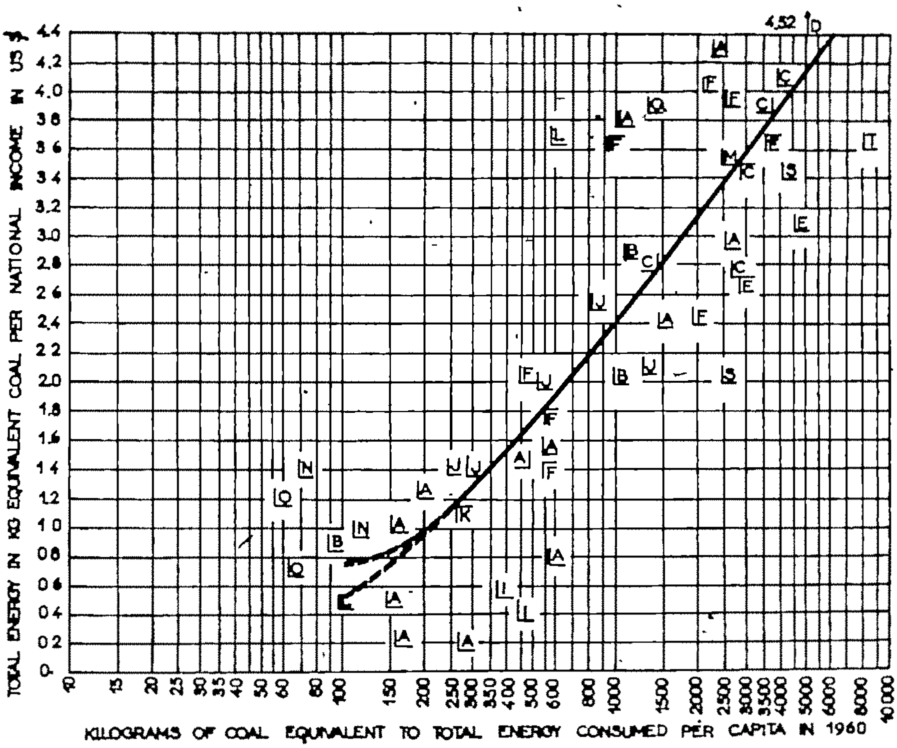

Fig. 1

To arrive at the equivalent in dollars for the national income of each of the countries plotted, the national income figures in local currencies and the exchange rates in terms of the U.S. dollar, given respectively in Sections XIII and XIV of the *United Nations Monthly Bulletin of Statistics*,[5] were used.

It would be presumptuous to say that the consumption of energy, *per se*, generates national income, but it is proper to interpret Fig. 1 from the point of view that the achievement of higher national income requires the application, to productive uses, of power, industrial, transportation and other equipment, all of which, plus the services to make these possible, consume energy.

It is, therefore, particularly meaningful to note that there is relatively little 'dispersion' within the considerable range covered.

On an overall basis, as suggested by the 'average' curve drawn through Fig. 1, the total energy content of national income can be conveniently estimated by assuming an average cost of energy of $0.01 per kg of coal as indicated in Appendix 3.

The scale of ordinates of Fig. 1 can thus be directly read as an approximate percentage of the total energy contents of national income, ranging, as can be seen, from 0.7 to 4.6%.

Since there is approximately as much energy consumed in areas averaging more than 2,850 kec per capita as there is in countries averaging less than this value, 2,850 kec per capita can be regarded, on an area basis, as a 'median' for per capita use of energy.

Since, for this abscissa, Fig. 1 reads 3.5 kec per dollar, it can be said that, as an area 'median', there was, in 1960, 3.5 cents of total energy consumed for each dollar of national income generated, and this can be regarded as a very approximate but convenient yardstick.

Conversely, the lack of energy resources, when needed for productive uses, might, as an average, prevent national income from being generated in an amount equal to $\frac{100}{3.5} = 28$ times the cost of the energy deficiency. The saying 'For want of a nail, the battle was lost', can be appropriately applied to the critical importance of never falling short of meeting energy requirements.

Ratio of consumptions : electrical energy to total energy—1960

Fig. 2 plots the ratio between the use of electrical energy and of total energy, both of these converted to their coal equivalents.

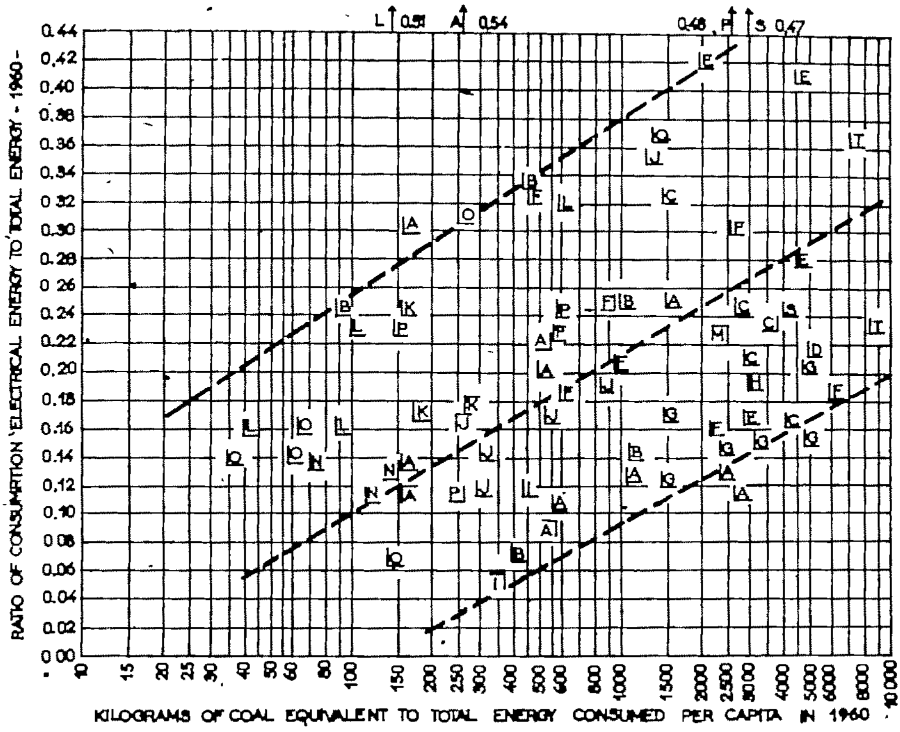

Fig. 2

The dispersion is unusually pronounced and reflects the wide variations, throughout the countries of the world of the availability of exploitable hydro-electric resources, etc., and, although, for the world as a whole, the average use of electrical energy in per cent of total energy, in 1960, was 21%, for particular countries this, as can be seen, ranges anywhere from 5 to 40%.

In order to guide the eye through this dispersion of country points, three broken lines have been drawn indicating the upper and lower limits and the average trend within the range covered.

Yet, although its relative importance percentage-wise varies, electrical energy can always be counted upon, as borne out by Fig. 1, to 'integrate' itself interchangeably with the other forms of energy, within the total amount required.

It is of interest to note, in Fig. 2, the trend towards increasing uses of electrical energy, in per cent of total, for increasing values of total energy per capita.

Annual increase of consumption of electrical energy (1955 to 1960)

On the other hand, Fig. 3, which shows the annual growth of consumption of electrical energy, when plotted against consumption of total energy per capita, brings out a greater degree of consistency.

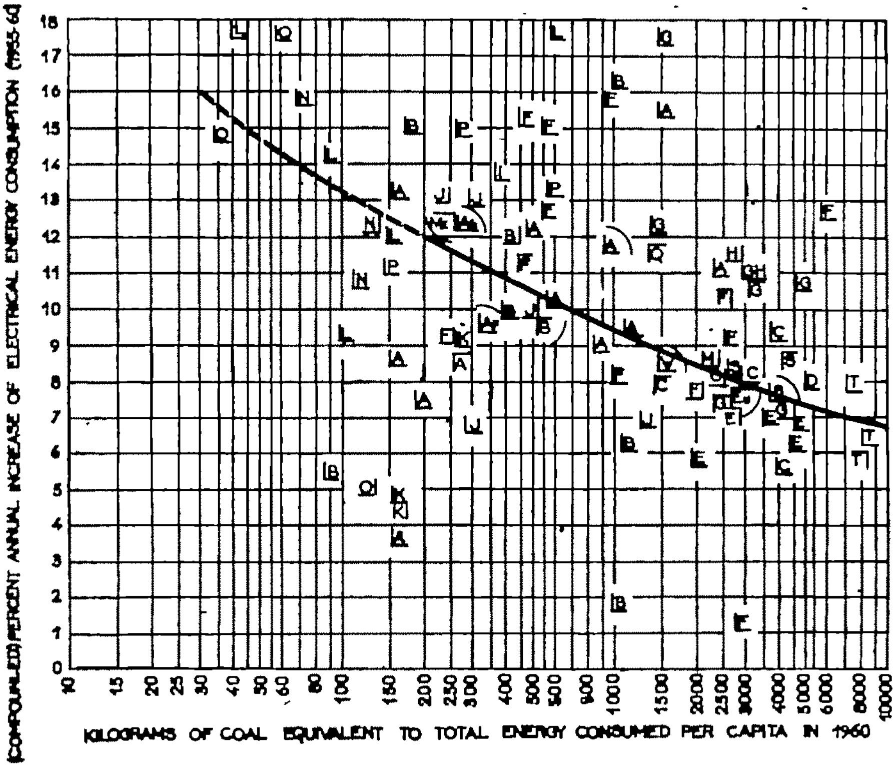

Fig. 3

In other words, although there are wide variations in the relative uses of electrical energy throughout the world, the rate of growth of its consumption is fairly consistent. Whatever the extent to which electrical energy contributes to the total consumption of energy, the use of the former will grow at a fairly closely predictable rate.

It is interesting to note from Fig. 3 that the 'standard' rate of growth of 7% per year, which is generally associated with the use of electrical energy (doubling in 10 years), and which happens to be a correct average rate for countries in the range of 5,000 to 9,000 kec per capita, is exceeded to a considerable extent throughout the numerous areas of the world which average a smaller use of total energy per capita.

Because the dispersion is particularly pronounced for the low values of kec per capita, a corresponding portion of the 'average' curve has been shown as a broken course.

Annual increase of consumption of total energy (1955 to 1960)

Fig. 4 shows, similarly, the rate of growth of total energy, and, like Fig. 3, indicates a marked trend towards slower rates of growth for the more highly industrialized countries.

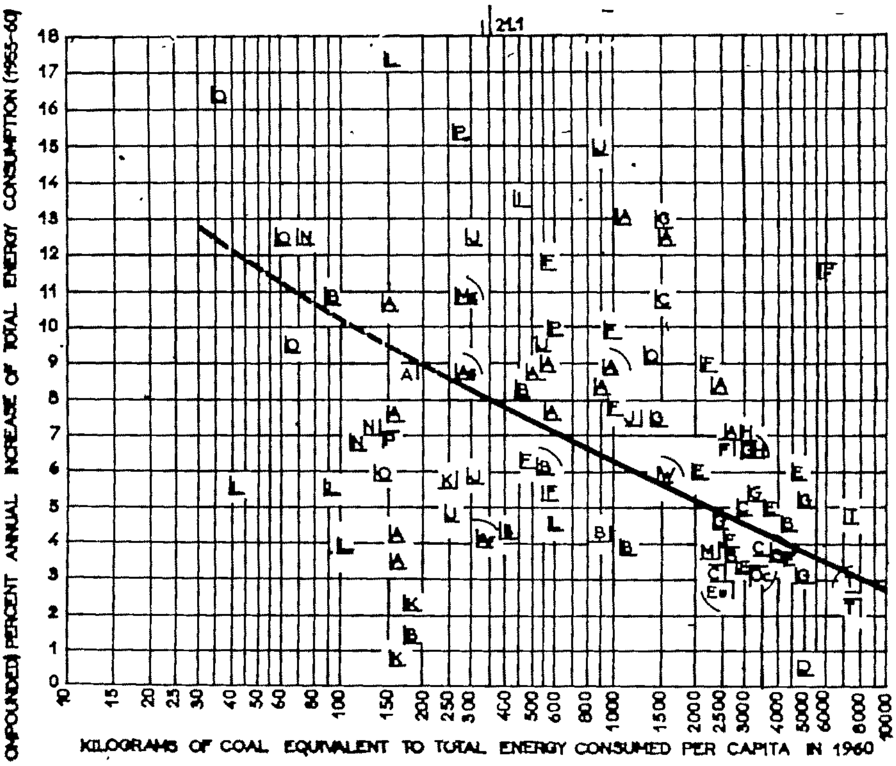

Fig. 4

This means that whether countries consume 50, 500, or 5,000 kec per capita, and as they become more highly industrialized, and consume still more energy per capita, there is a marked trend towards a decrease in the annual rate of growth of the consumption of electrical energy and of total energy as well!

This follows, as illustrated in Fig. 1, from the greatly increased contents of total energy per unit of national income that must be provided as countries progress towards greater industrialization and means that in the earlier stages of industrialization, a country's consumption of energy must increase at a faster initial rate than will be required to be maintained in later stages.

The same as in Fig. 3, and because of the very wide dispersion for the low values of kec per capita, the corresponding portion of the 'average' curve has been shown as a broken course.

Comparison between rates of growth of consumption for electrical and for total energy

Comparing 3 and Fig. 4, also cols. X and XV of the statistical tabulation, brings out that the rate of growth of electrical energy use is, on the average, 3.5% greater than that of total energy and this is submitted here as a convenient approximation.

Thus, through its faster rate of growth, electrical energy will always displace, percentagewise, some of the other forms of energy, which, however, will continue to grow within the continually increasing total requirements for energy as a whole.

For instance, taking a country (this might well be the U.S.A.) where, in 1960, on the basis of an equivalence of 0.4 kg. of coal per kWh, 23% of the total energy was consumed as electrical energy, the following can be easily calculated :

Assuming a 2.7% rate of growth per year for total energy ..	100 in 1960
Will become ..	114 in 1965
Assuming a 6.2% rate of growth per year for electrical energy ..	23 in 1960
Will become ..	31 in 1965

Thus, in these five years, the share of electrical energy will increase from 23 to 27%.

Annual increase of national income (1955 to 1960) and annual increase or decrease of the ratio of total energy to national income

In preparing these two curves (Fig. 5 and Fig. 6), data showing, for 43 countries, the annual rate of depreciation of their currency, compounded for the same five-year span : 1955-1960[4], were used supplementally to Section XIII of the *United Nations Monthly Bulletin of Statistics*,[5] in order to arrive at the annual percent increase of their 'real' national income during this same period.

These corrections range between an appreciation of 0.2% and depreciation of 5.2% (the figure for the U.S.A. is 2.1%).

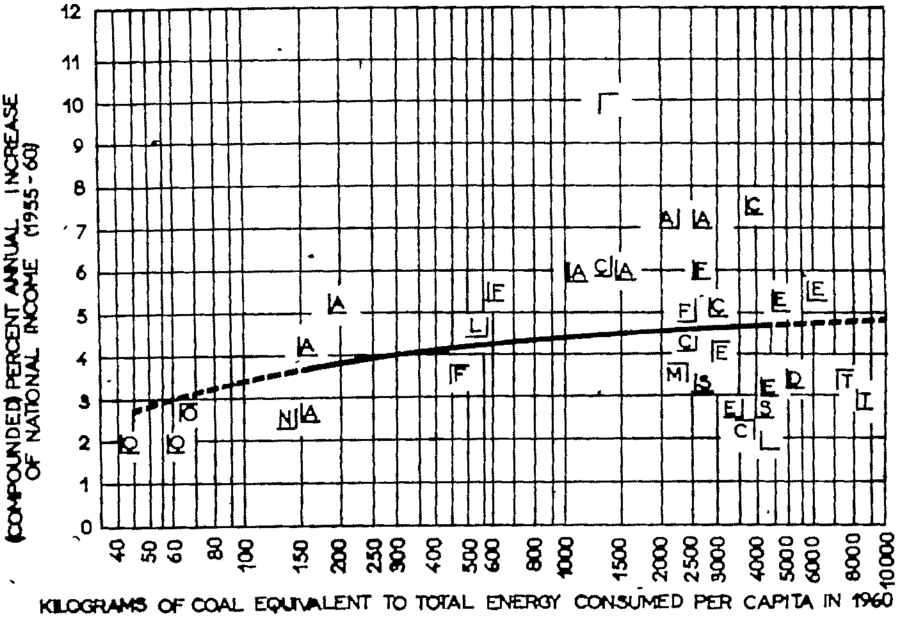
(COMPOUNDED) PERCENT ANNUAL INCREASE OF NATIONAL INCOME (1955-60)
0
1
2
3
4
5
6
7
8
9
10
11
12
40
50
60
80
100
150
200
250
300
400
500
600
800
1000
1500
2000
2500
3000
4000
5000
6000
8000
10000
KILOGRAMS OF COAL EQUIVALENT TO TOTAL ENERGY CONSUMED PER CAPITA IN 1960

Fig. 5

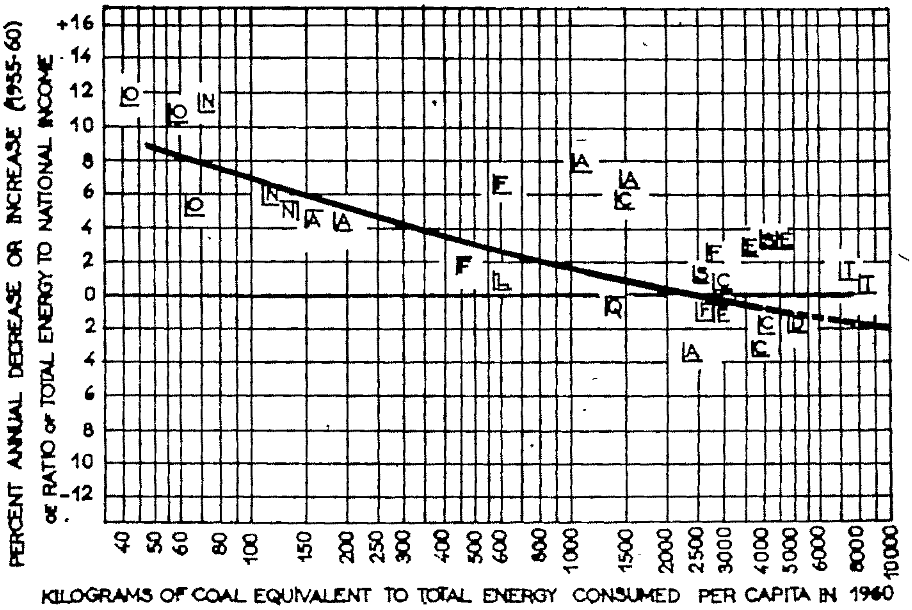
PERCENT ANNUAL DECREASE OR INCREASE (1955-60) OF RATIO OF TOTAL ENERGY TO NATIONAL INCOME
+16
14
12
10
8
6
4
2
0
2
4
6
8
10
-12
40
50
60
80
100
150
200
250
300
400
500
600
800
1000
1500
2000
2500
3000
4000
5000
6000
8000
10000
KILOGRAMS OF COAL EQUIVALENT TO TOTAL ENERGY CONSUMED PER CAPITA IN 1960

Fig. 6

It should be pointed out that the only countries entered in Figs. 5 and 6 are those where the rate of exchange, in terms of the U.S. dollar, had remained unchanged from 1955 to 1960. This accounts for the smaller number of points shown in these two analyses and also for the greater extent to which the 'average' curve plotted departs from what might appear to be a more representative course.

Fig. 5 indicates that total national income can increase at faster rates as the use of total energy per capita increases but there is considerable uncertainty at both ends of the curve and it is hoped that a closer representation can be obtained as data for a greater number of countries become available for 1961 and 1962.

In Fig. 6, the annual increase of the ratio of total energy to national income (plotted as percent annual change of the kec per dollar figure in Fig. 1) strikingly brings out that, whereas total energy requirements increase faster than national income for countries in the 'less than the 2,500 kec per capita' range, the reverse is true for countries in the 'higher than 2,500 kec per capita' range.

This would indicate that, at around 2,500 kec per capita, the contribution made by the use of additional amounts of total energy and the achievement of greater national income are in balance, both of these increasing at the same rate.

Above that area, an increase in national income is generated with a relatively smaller increased expenditure of total energy, which trend is easily understandable, in view of the greater efficiency and productivity and the greater concentration on more expensive forms of national product, for the more highly industrialized economies.

In the light of Fig. 1, the trend expressed in the above paragraph may be expressed by saying that, the higher the use of energy per unit of national income, the greater the gains in overall economic efficiency which are realized as additional energy is expended towards the achievement of higher national income.

Annual increase or decrease of the ratio of electrical energy to national income

Fig. 7 recapitulates the average curves from Figs. 3, 4, 5, and 6. In addition, it shows the per cent annual increase or decrease of the ratio of electrical energy to national income.

It should be noted that, whereas these five average curves were plotted independently, directly from country points, they relate to only two groups of data:

Annual rate of increase of:

Consumption of total energy	Consumption of electrical energy
National income	National income
Ratio of consumption of total energy to national income	Ratio of consumption of electrical energy to national income

and, had the separately obtained average curves not been fairly representative, the above relationship would not have verified itself.

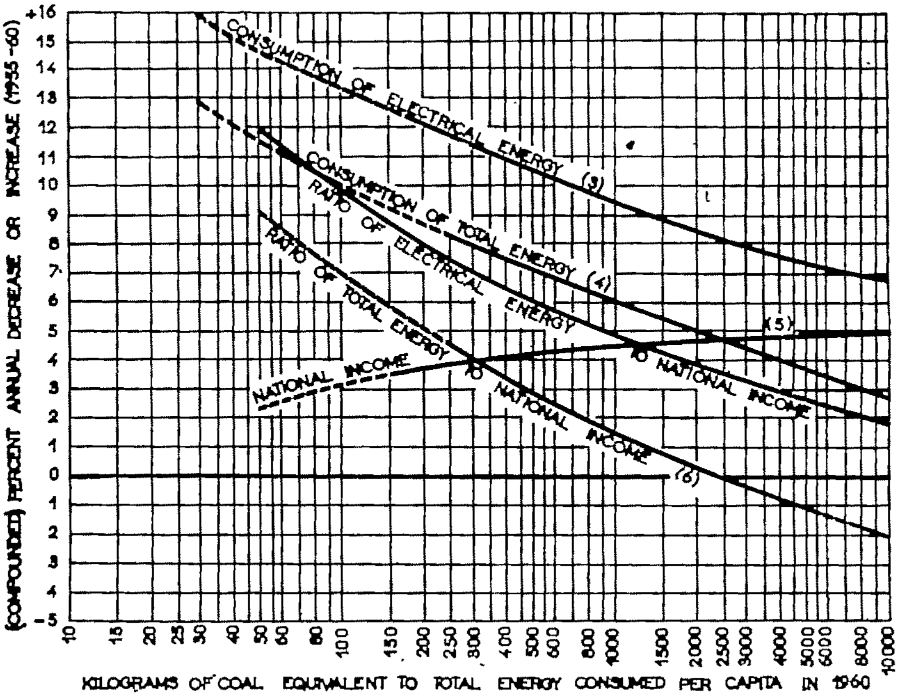

Fig. 7

It is interesting to note that, whereas, at approximately 2,500 kec per capita, national income increases at the same rate as the consumption of total energy, the consumption of electrical energy always increases faster than national income, even at 10,000 kec per capita.

At approximately 1,150 kec per capita, the consumption of electrical energy increases as the square of national income. Thus the average approximation, made by the author in his 1955 paper, that the use of electrical energy increased as the square of national income, is applicable only in the vicinity of 1,150 kec per capita.

Correction for population growth

It will be noted that the element of population growth has not been mentioned; rates of increase are plotted on a country basis since this is convenient when a country, or a utility, make plans for meeting increased energy demands.

If found necessary, the correction for population growth is a very easy one to make : from 1955 to 1960—the period of years spanned by this study—world population increased from 2,691,000,000 to 3,015,000,000, an annual growth rate of 2.3%, which, since emphasis has been an approximate averages can conveniently be used to correct rates of growth for energy or income from a 'country' basis to a 'per capita' basis. (In the U.S.A., for instance, the annual rate of population increase during the same five-year period was 1.8%.)

Omissions from primary energy totals

Because of the lack of reliable information on wood and wastes, the United Nations statistical papers have not included these in the totals for solid fuels but the use of peat, wherever important, has been included. The absence of the data on the use of wood and waste represents, therefore, the only significant omission from the totals presented.

Since the use of nuclear fuels for power generation purposes had not reached significant amounts by the end of 1960—the last year covered by this study—this primary source of energy has not been listed but the nuclear fuel generated electricity totals in kWh are included in cols. VII and IX of the statistical tabulation.

Electrical energy, total energy and national income

In a previous section of this paper an approximate average for the total energy contents of national income was indicated and it is of interest to note that for 20 countries averaging 3.5 kec per dollar, the individual values ranging from 2.75 to 4.25 kec per dollar.

For these 20 countries, the average content of electrical energy was 2.12 kWh per dollar,* the individual values ranging from 0.8 to 3.5.

This leaves for other forms of energy, an average of 2.56 kec per dollar, the individual values ranging from 1.84 to 3.5 kec per dollar.

(As a matter of interest, for the U.S.A., in 1960, the contents of energy per dollar were 3.6 kec=2.04 kWh +2.8 kec).

With such a wide dispersion range, which, as will be noted, is especially pronounced in the use of electricity, averages are of little significance; however, these are indicated here to emphasize that the share of the production of electricity in the total energy (world average 21%) must always be associated with the other non-electricity producing forms of energy (world average 79%) in order to arrive at a total, more representative of the national income which all forms of energy together contribute to generate.

Recapitulation

It has been the aim of this study, without attempting to forecast the future, and without emphasizing the performance of specific countries, but simply by 'letting the record speak' and point to whatever trend might become apparent to arrive through the plotting of data available for 85 countries, at general relationships, from which average trends can be estimated over a short term, such as would be spanned by a five-year plan.

In spite of the considerable amount of 'country points' dispersion noted, it has been possible to arrive at 'average' curves which may be regarded as fairly indicative especially since, as explained in page 5, each average curve independently arrived at, was checked against other related curves thus making it possible to improve on the significance of the more doubtful areas, shown in broken courses.

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* The author's paper[1] gave 2.00 kWh per dollar as the probable weighted average for all points.

Although it might appear, in some cases, that undulating curves could have provided a more accurate representation, it was deemed preferable, in this first study, to adhere to the simpler plotting and it is expected that subsequent revisions of this study, as the data for successive years become available, will make it possible to improve on the degree of significance attached to the relationships which have been analyzed.

It is hoped that, besides providing an accurate statistical record of the use and rate of growth of consumption of the various forms of energy, this paper will bring out useful general approximations for annual increases of : electrical energy consumption, total energy consumption, and national income.

The considerable amount of attention recently placed on comparison of growth rates, national income-wise, illustrates the great extent to which substantial departures from the average performance indicated can be expected to result from the interplay of economic forces, but the departures on either side of the average are well within the variations to be expected.

The average record, which has been the sole aim of this study, is most meaningful and encouraging : as countries become more and more industrialized, they can increase their national income faster, percentage-wise, and they can achieve this while slightly reducing, percentage-wise, their demands for energy.

Acknowledgment

In the text proper, the all important contribution of several United Nations studies 2, 3 and 5 has been gratefully acknowledged, but the author would like to reiterate here his deep appreciation for the unique extent and prompt availability of the worldwide data so efficiently compiled and provided by the United Nations Statistical Offices.

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2. United Nations Statistical Papers, Series J, no. 3 : 'World Energy Supplies', 1955/1958, p. 6.
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4. 'Towards a New Energy Pattern in Europe'. Report prepared by the Energy Advisory Commission to OEC under the Chairmanship of Prof. A. Robinson, January 1960, pp. 89-90.
5. 'Section XIII-National Income' and 'Section XIV-Finance'. *United Nations Monthly Bulletin of Statistics.*
6. 'Depreciation of Money.' *Monthly Bulletin of the First National City Bank of New York*, May 1961.

Appendix 1

Coefficients of equivalence and energy contents for various fuels and for electricity

	Coal equivalent (metric tons)	Energy content, 10^3 kilocal.
1 metric ton anthracite and bituminous coal ..	1.0	7,000
1 metric ton of coke of anthracite or bituminous coal ..	0.9	6,300
1 metric ton of lignite ..	0.3 to 0.6	2,100 to 4,200
1 metric ton of crude petroleum ..	1.3	9,100
1 metric ton of gasoline, kerosene, fuel oil 1,000 m.³ natural gas ..	1.5	10,500
	1.33	9,310
1,000 m.³ manufactured and coke oven gases ..	0.6	4,200
1,000 kwh electrical energy (hydro) ..	0.375	2,625
1,000 kwh electrical energy (thermal) ..	0.4	2,800
The above energy contents are consistent with :		B.Th.U.
1 lb. of coal ..		12,600
1 lb. of liquid fuel ..		18,000
1,000 c.ft. of natural gas ..		1,050,000

Appendix 2

Explanatory comments pertaining to cols. I through XV of Table 1

Cols. I through VII are correlated: Multiplying 'population' in col. I by 'total energy consumption per capital' in col. II verifies 'total energy' in col. VII.

The energy consumption aggregates in cols, III, IV, V, and VI for hydro-electricity, solid fuels, liquid fuels, and natural gas add up to the total in col. VII, and the percentage figures, under each of the respective amount in the same columns, add up to 100%.

'Per capital' and 'aggregate electricity' consumption in cols. VIII and IV are correlated by 'Population' in col. I.

All the data, in cols. I through IX, apply specifically to the year 1960. Differing from these, the percentage values in cols. X through XV apply to the 'compounded' rate of annual increase between 1955 and 1960, and were obtained by subtracting 1 from the fifth root of the ratio of the 1960 to the 1955 totals.

Cols. XI through XIV, each of which shows the rate of increase of each of the four primary sources of energy, are directly correlated with col. XV, which shows the rate of increase of total energy.

The individual percentages shown for the 1955-1960 five-year span in cols. XI through XIV apply to the contributions in varying amounts such as are indicated in cols. III through VI, from each of the corresponding sources, for the year 1960. If col. III through VI had shown the average percent contribution from each source, for the 1955-1960 period, the application of the 1955-1960 annual increases in percent to the 1955-1960 average contributions would have verified the percent annual increase in total energy in XV.

Under the respective 'individual' percentage figures in cols. XI through XIV are shown the percentages which give the exact additive contribution of each of the four sources to the total increase in col. XV.

Since the four groups of energy contribute in widely varying amonts to the generation of electricity, the annual rate of increase of total electricity consumption shown in col. X has no direct correlation with any of the other percentages (cols. XI through XIV).

Appendix 3

Range of magnitude assumed for cost of energy and average of range

For the cost of energy, a range of magnitude has been assumed of :

Corresponding to	$0.30-0.42	per MM B.Th.U.
	0.315-0.44	per 1,000 c.ft. of natural gas
	11.90-16.70	per 10 MM kilocal:
	8.33-11.69	per metric ton of coal
	1.80-2.52	per lb. of fuel oil
Average of that range	$0.36	per MM B.Th.U.
	0.37	per 1,000 c.ft. of natural gas
	14.30	per 10 MM kilocal.
	2,16	per lb. of fuel oil
Is equivalent to	10.00	per metric ton of coal
Or,	0.01	per kg. of coal

Appendix 4

Bar charts showing electricity and energy consumptions for 10 areas of the world

Fig. 8 and Fig. 9 have been prepared in order to give a simplified visual representation of some of the data in Table 1, both for 1955 (white bars) and for 1960 (white bars extended by white areas representing the differences between the annual consumption in 1960 and in 1965).

CONSUMPTION OF TOTAL ELECTRICITY BY GEOGRAPHIC AREAS OF THE WORLD IN 1955 AND IN 1960

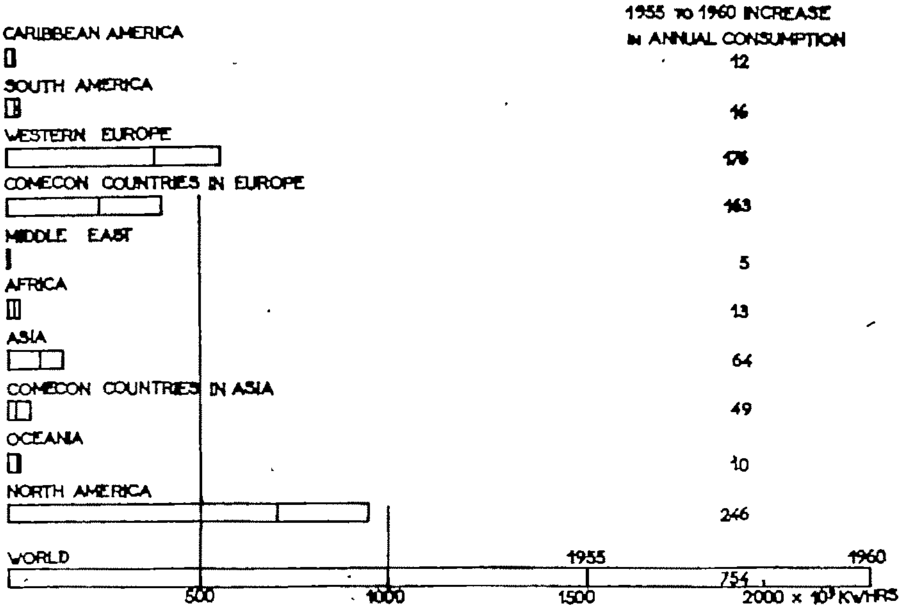

Fig. 8

CONSUMPTION OF TOTAL ENERGY BY GEOGRAPHIC AREAS OF THE WORLD IN 1955 AND IN 1960

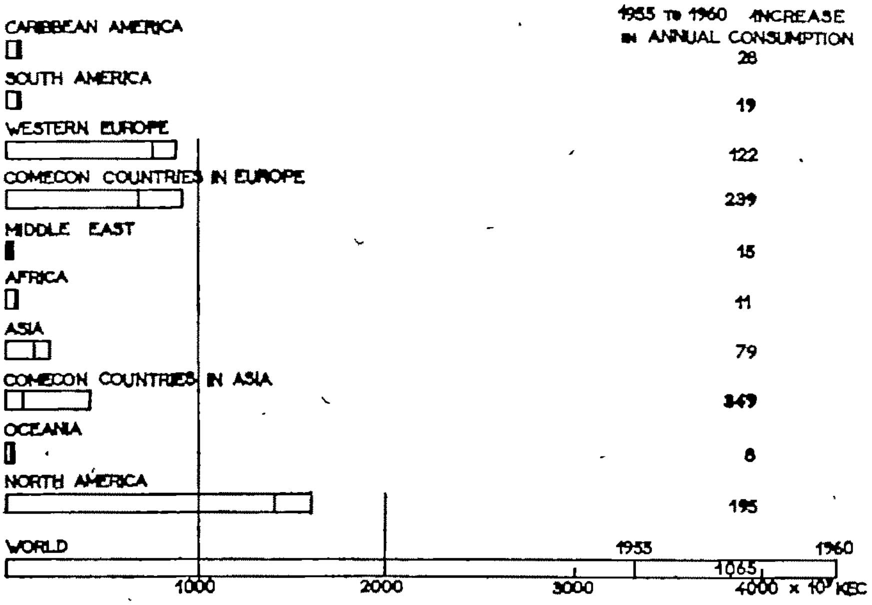

Fig. 9

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Nagpur Centre

Chairman's address by Shri K. S. Ramu, B.A., B.E., M.I.E., at the Sixteenth Annual General Meeting of the Centre on December 22, 1962

After welcoming the Chief Guest, Justice Shri S. P. Kotwal, Vice-Chancellor of the Nagpur University, and other invitees, Shri Ramu thanked the Committee of the Centre for electing him Chairman for 1962-63.

Delivering the Chairman's Address, he said, 'The Institution was founded in 1921. The membership then was 138 and we are now having 18 Local Centres with a total membership of nearly 32,000. The major objectives of the Institution are advancement of science, practice and business of engineering in all its branches. It is for the promotion of pooling of engineering knowledge with a view to developing research and providing experts for investigation, design, construction and operation. The Institution represents all branches of engineering, *viz.*, civil, mechanical, electrical, electronics and telecommunication, chemical, mining and metallurgy and general engineering.

The Local Centre of Nagpur is also gaining strength from year to year. The total membership has increased from 540 to 670 and the corporate membership of this Centre is 178 which shows an increase of 22% over that of the previous year. In this connection, I like to point out that this Local Centre of the Institution is not having representation in the Nagpur University so far and it is felt that the university authorities consider the advisability of having a representative of this Centre in the university as early as possible.

This centre is doing a great deal to promote the objective of the Institution by holding periodical lectures and arranging film shows on subjects of interest to engineers. I request all eligible engineers in the region who have not yet become members, to get themselves enlisted by filling in the admission forms and sending them to the Institution duly sponsored. We have a good library in this Centre and every year new books are being added to enable the members including the members of the students chapter to take advantage of these facilities.

Engineers have to keep themselves up-to-date with new techniques. They have to carry out the task assigned to them with maximum economy and speed without sacrificing quality since, quality is the hall-mark of all good technical work. In this connection, I like to recall what Maj.-Gen. Harkirat Singh said last year at Calcutta in his Presidential Address, 'If our work is costly or slow, we can still have the satisfaction of having done something, but if at the end of it all the quality of our output in construction or manufacture is poor, we can only hang our heads in shame'.

Our country is now on the threshold of great developments during the Third Five Year Plan. Out of the total provision of Rs. 10,400 crores, 60% relates to irrigation, power, industries, transport and communications for which the engineers have to shoulder the task and responsibilities. The success of these plans depends on the engineers to a great extent, to their professional integrity, discipline and team work. The nation would naturally expect from the engineers wise, honest and economic use of these funds. I have to mention that although the engineers' position today is of high responsibility, it is without commensurate authority. Nobody can operate effectively or be held responsible for the work unless he has the necessary authority to do it. It is therefore necessary that, the engineer who is responsible for the results, is given the necessary authority and liberty of action. As the committee on the plan project has recently suggested, more power should be given to the executive engineers and the superintending engineers in the matter of sanction and acceptance of tenders. Also a new system of administrative and financial controls designed to encourage initiative at every level and ensure quicker execution of every project have to be implemented.

Our country, since September this year, is passing through a great national emergency created by the Chinese aggression. Our nation has shown a sense of unity, eagerness for hard work and preparedness for any sacrifice for ousting the aggressor from our soil. To meet this grave situation, we have to vastly increase our productivity. Our slogan today is 'either to produce or perish'. Every ounce of our energy must be directed towards defence of our country's borders by all persons in all walks of life. As our Prime Minister has been repeatedly stressing, modern wars are fought as much in the fields of battle as by persons and workers who labour hard for increasing production on the farms and in the factories. Every peasant in the field and every worker is to that extent regarded as a soldier in times of national emergency.

Generous contributions have to be made quickly to the Defence Fund. In accordance with the decision of the Council of the Institution taken at a special meeting in New Delhi on the 13th November, 1962, the President of the Institution has made an appeal to members to make a contribution of at least the equivalent of one year's subscription to the fund and that the same be preferably sent before 1st January, 1963 to the Secretary at the Head Quarters office at Calcutta. I am sure that all the members of this Institution would do so in time in response to this call. As the collection of the funds would take time, the Council has made an advance payment of rupees one lakh immediately to the Prime Minister of India for the National Defence Fund.

Consequent on this national emergency, the priorities of the Third Plan may have to be re-arranged but the basic approach to the Plan would remain unchanged, *viz.*, to provide the basic necessities to all citizens, more especially food, supply of drinking water, clothing, elementary education, health and sanitation, housing and gradually to provide work for all. At the same time, the Plan seeks to secure social and economic order based on the values of freedom and democracy.

We have to step up agriculture, communication, development of power, technical education and other selected economic programmes which are directly or indirectly connected with the defence purposes.

With regard to agriculture, a total outlay of Rs. 650 crores has been made in the Third Plan under the head irrigation which includes Rs. 80 crores for river flow control, drainage, water-logging and sea erosion.

In regard to the road plan, it is aimed at bringing every village in a developed agricultural area to within 4 miles of the metalled road and within 1½ miles of the *katcha* road. Even for this, a modest target Rs. 5,000 crores is estimated and during the Third Plan, Rs. 350 crores have been proposed to be spent. It is hoped that larger amounts would be spared in succeeding plans.

Lack of adequate protected water supply and sanitation facilities are responsible for the high incidence of water-borne and filth-borne diseases. High priority will continue to be given in the Third and succeeding Plans to provide safe drinking water in the villages. In respect of the provision of water supply to urban areas, the rapid growth of the urban population has to be taken into account for carrying out the programme of augmenting water supply and improving drainage. It is essential that the different parts of the projects are taken up in the correct sequence with one another at each stage and at the same time, water supply and drainage are taken up as coordinated programmes. Here, I must mention that the Central Public Health Research Institute at Nagpur has been very actively investigating and giving their expert technical aid and advice on various problems connected with public health engineering.

I will now deal with power development which is the prerequisite of industrial expansion and overall economic growth. As many of you would be interested to know the planning of new power schemes in the thirteen districts of Vidarba, Khandesh and Marathwada areas which are under the jurisdiction of this Centre, I would briefly mention the following :

The allocation for the execution of thermal generation, transmission and distribution schemes is about Rs. 57 crores subject to adjustments and the salient features of the schemes proposed are as under.

Khaperkheda power station and Vidarbha grid scheme extensions

Two additional 30,000 kW turbo-alternators with ancillary equipment are being provided. This construction work is already in progress and is expected to be completed by the end of 1963 or early 1964. Thus, the generating capacity of this power station will be doubled from the present 60,000 kW to 120,000 kW. This will meet the immediate additional power requirements of ferro-manganese plants and the explosives factory at Bhandara and other industries in the Vidarbha region.

One 60,000 kW turbo-alternator set at the Paras power station will be installed, thus trebling its capacity from 30,000 to 90,000 kW.

The power stations at Khaperkheda and Paras will be further interconnected by 132 kV double-circuit transmission lines.

Again 66 kV double-circuit lines will be constructed from Khaperkheda to Madgi (near Tumsar) *via* Bhandara and a 66 kV substation will be established at Bhandara for the explosives factory project. This large project for the manufacture of certain explosives is being undertaken by the Defence Department under the charge of Col. J. S. Sandhu, Chief Engineer. It is expected that the scheme would be ahead of the schedule and the work on the 66 kV transmission line which has already started is expected to be completed in time for production.

A new 60,000 kW steam station will be installed at Bhusaval. The two power stations at Paras and Bhusaval will be interconnected by a 132 kV double-circuit line and will serve the Khandesh and Marathwada areas by suitable 132 kV, 66 kV and lower voltage lines. The other main transmission line and substations to be commissioned in that area are:

(i) 132 kV double-circuit line from Bhusaval to Manmad with 132 kV substations at Pachora, Chalisgaon and Manmad;

(ii) Construction of 132 kV single-circuit line from Chalisgaon to Dhulia and an 132 kV substation at Dhulia;

(iii) 132 kV single-circuit line from Paras to Parbhani *via* Eldari with 132 kV substations at Eldari and Parbhani. The Purna hydro-electric station at Eldari which is under execution will be interconnected with this system at Eldari substation; and

(iv) 66 kV substations at Jalna and Aurangabad by an extension of 66 kV line from Eldari substation and at Purli and Nanded by extension of 66 kV lines from Parbhani substation.

Although the rate of progress is impressive, the requirement of electric power rises so rapidly with the expansion that it is anticipated that our power shortage will continue for a long time. Therefore, doubling and redoubling of generating capacity will be a normal feature of the next few five year plans.

Rural electrification scheme

Eighty percent of the population reside in villages and their chief source of livelihood is agriculture. Electricity has long passed the stage of luxury and has now become a great necessity. The rural folk now appreciate the conveniences that can be derived from the diversified uses of electricity for the home, for cottage and small scale industries, and for irrigation and agricultural purposes; thereby the earning capacity and the living standard of the millions can be raised. The amenities brought about by extending electric service to rural areas help also in checking the tendency among the rural population to migrate to urban areas. Thus, it is seen that rural electrification assumes a significant role in the country's power development programme.

In the Second Plan, Rs. 75 crores was provided for rural electrification, and in the Third Plan, Rs. 105 crores has been allotted for the electrification of villages. This will enable supply of electricity to about 20,000 villages, bringing the total number of electrified villages to 50,000. Even this would mean that only about 9% of the total of 5,60,000 villages will be electrified by the end of the Third Plan.

In Maharashtra, rural electrification has gained a considerable momentum during the last few years. In the eight districts of Vidarbha, 627 villages were electrified by March 1961. It is expected that by March 1964, 1,100 villages would be having electricity out of the total of 12,523 villages and it is also expected that 10,000 agricultural pumps would be connected up. It has to be mentioned that almost all villages with a population of 5,000 have already been electrified, and by the end of the Third Plan many villages with a population of 2,000 would be getting electric supply and priority would be given to those villages which have demand for agricultural pumps.

Per capita consumption

The per capita consumption of electricity can be taken as an index of industrial development and as the yardstick for judging the standard of living of the people. Five years back, the per capita consumption in Vidarbha was 17 kWh per head per year. Now it is of the order of 33 kWh. After the commissioning of the additional generating capacity of 120,000 kW and on completing the network for the distribution mentioned above, it is expected that the per capita consumption in Vidarbha would increase to 60 kWh by the end of the third plan, after taking into account the increase of population at the rate of 1,98% per annum which has been the rate of growth during the last decade.

The per capita consumption figure of our country for 1959-60 was 35 kWh and at the end of the Third Plan, this is expected to increase to about 80 kWh, when the generating capacity would be increased from 5.8 million kW to 11.8 million kW. The total provision made under the Third Plan for power is Rs. 925 crores. The per capita figure by the end of the Fourth Plan is expected to be 115, when the generating capacity would be increased to 22 million kW. Compare these figures with those of some of the progressive countries in the world. Even five years ago, the per capita consumption in some foreign countries were as given below :

Norway	.. 5,700 kWh
Sweden	.. 3,000 kWh
Australia	.. 1,500 kWh
U.K.	.. 1,300 kWh
Japan	.. 930 kWh
Italy	.. 920 kWh

All this shows how backward we still are, in spite of many mineral and agricultural resources we have in this country. In Vidarbha nature has been very kind to us. We have coal, iron, manganese and plenty of water. Only it has to be properly harnessed and utilized. To come up to the standard of other advanced countries we have to strive really hard to be self-sufficient in our basic requirements as early as possible. This calls for ingenuity on the part of engineers, industrialists and the planners of the country, whose motto should be 'hard work and still harder work'.

In the initial stages, short-term plans are necessary but in doing so it must take into account the long-range planning for the next 15 to 20 years. Into this long-range plan, the Five Year Plan should be dovetailed. Each plan should flow from the preceding plan and telescope into the next one. As our beloved Prime Minister has said, 'Just as the flow of life is continuous, planning and development which try to regulate the flow of life of a nation are also a continuous process ; so ultimately there are no resting places in the journey we have undertaken'.

The assessment of man power requirement and the training of technical personnel for the Third and the Fourth Plans are among the basic conditions of success of these plans. Provision has been made in the Third Plan for expansion of facilities at the degree and diploma levels so as to increase the annual admission from 13,000 to 19,000 for degree course and from 25,000 to 37,000 for diploma courses.

In our own State, there are eight engineering colleges. Also there are four polytechnic institutions in Vidarbha and Marathwada and there are seven industrial institutes under the craftsman training scheme in this region. Part-time training to train students for Sections A and B examinations of the Institution has been started under the Ministry of Defence. The Engineering Tutorial College has, as its senior officer-in-charge, Col. J. S. Sandhu, Chief Engineer, Explosives Factory Project, Nagpur. The courses are of 3 years duration ; 1½ years for Section A and 1½ years for Section B. The course is mainly meant for serving personnel—Central and State Government employees and private bodies. The classes are conducted in the evening from 6.00 to 8.00 p.m. to enable the persons who are in service to avail of the facility to further engineering knowledge and prospects. It is considered that the normal requirements of the engineering personnel will be met in the third plan.

It has been stated by Dr. A. N. Khosla, while addressing the 14th Convocation of the Roorkee University that we require more in numbers and more of quality and depths and more specialization to meet the requirements of industries and defence. He stated that we have still to look to outsider for solving our problems. He said that we require high class engineers and scientists to man our design organization and consulting services both of which are woefully inadequate. He suggested that the pattern of engineering education should undergo a radical modification in keeping with the rapidly advancing frontiers of sciences and technology to meet the demand of the nuclear and space age.

Engineers have unique opportunities to serve the nation through their profession, particularly in the present national emergency. The Council of the Institution have already conveyed to the Government of India its resolution to place the technical resources and knowledge of the Institution at the disposal of the Government. We are confident that we shall strive our best and rise to the occasion to fulfil the great tasks that lie ahead.

The nation that shows will and determination to pursue her cherished goal in times of crisis is bound to succeed not only in winning the war but also in winning peace.'

Summaries of Papers Published in the Journal, vol. 44, no. 3, pts. CL 2 and ME 2, November 1963

CIVIL ENGINEERING DIVISION

Planning in Construction of Projects

N. S. Bhat
Non-member

In this paper, a broad outline of planning the construction of buildings (for establishing an industry), taking into consideration various factors such as location of factory site, construction of buildings, general layout of buildings and cost of proposed buildings, is given.

Use of Building Lime

A. K. Bhowmik
Associate Member

Lime is in use as a cementing and finishing material in building construction from the olden days in India. The quality of the workmanship with lime is evident in many monumental buildings of the past. Although the use of lime became limited with the advent of Portland cement, in recent years, it is being realized that lime or a mixture of lime and Portland cement can be used with better advantages in certain types of construction. However, much depends on the selection of the proper type of lime out of the diverse varieties of the same available in the market. This article deals with the various classifications of lime according to the setting properties, chemical composition and manufacturing process and indicates their suitability for different building works.

Sintering Fly Ash for Making a Lightweight Aggregate

S. K. Chopra
Non-member
and
C. S. Sharma
Non-member
and
Kishan Lal
Non-member

Sintering of fine powders is a well established process in metallurgy. Though sintering of fly ash with a view to producing a lightweight aggregate is a recent venture, it is of great interest to the building industry. The success of the commercial sintering plants in the more industrialized countries shows how the serious problem of disposal of huge quantities of fly ash can be solved profitably and a new material with special properties can be produced simultaneously. Since India has now started producing large quantities of fly ash at its thermal power stations and there is a persistent shortage of building materials, an investigation on the sintering of the Indian fly ash was carried out at the Central Building Research Institute. The results of the sintering test are reported in this paper.

Planning in Construction of Projects

M. S. Deshmukh

Non-member

In this paper, procedures for planning and construction of projects are suggested.

Role of Productivity in Construction

P. P. Dharwadker

Associate Member

The paper deals with the feasibility of the use of productivity techniques in industrial undertakings in general and the construction industry in particular. Combined with proper planning of the various phases of the project, whether in industry or housing, irrigation or power, transport or communication, productivity techniques in the manufacture of materials of construction as well as in the construction work have an important role to play. With the effective use of productivity techniques, it is possible to reduce the construction and production costs of large national projects. No efforts must be spared to coordinate productivity programmes in construction, with the programme of economic development of the country.

Plastics in Building

J. George

Non-member

The synthetic organic plastics are assuming an important part among the structural materials. They provide the design engineers and architects with a combinations of properties not obtainable in the earlier materials. This article describes the properties and principal applications of plastics in building construction.

Scope of Plastics in Civil Engineering Construction

Prof. M. V. Joshi

Associate Member

Plastics are occupying an important role as a versatile material of construction in almost every field of application and the tendency is now towards the utilization of these materials in components where specific properties are of critical importance. Engineers are generally reluctant to change from well established and familiar materials to less known materials such as plastics. This is partly due to the insufficient data regarding the properties and performance of these materials and also due to the relative ignorance on the part of engineers, with regard to new techniques involved in the design and fabrication of such materials. In this paper, properties of common types of plastics and their uses are given.

Machines Used in Engineering Construction

A. V. Keshava Rao
Non-member

Today India is making great strides in the fields of river valley schemes and industrial establishments. India is a country with plenty of manpower. Hence the necessity of machinery for engineering construction works was not felt so much. However, today, the impact of machinery in engineering works has been realized. Due to the increased tempo in construction and the desire to progress towards a better standard of living, India has embarked on multipurpose river valley schemes. The new industries and townships that are being constructed now are of large magnitude. Inevitably machinery is replacing manual labour. There are various types of machinery available in the market each capable of performing a particular type of job. The machinery commonly used in engineerng construction are described in this article.

Methods of Improving Speed in Construction

J. S. Mani
Non-member

In the post-freedom years, construction projects of various types and magnitude have been launched in the country. The successful completion of these projects is expected to ease the problems of providing the basic needs of the people, *viz.*, food, clothing and shelter. This article attempts to show the possible ways of improving the speed of construction without impairing quality and gives an approach to the problem keeping in view the conditions prevailing in our country.

Research in Materials and Construction

M. K. S. Naidu
Non-member

Tremendous impetus has been given to research in science and engineering techlogy in the present century. Though research in engineering technology as applied to building materials and construction is not so dramatic as that in space travel and atomic energy, still perceptible progress is being maintained. This paper attempts to substantiate the view by considering the three important materials, *viz.*, concrete, steel, and timber in building industry and the technique adopted in design and construction.

Methods of Improving the Efficiency in Construction Methods

Y. L. Subramanyam

Non-member

This paper discusses measures for improving efficiency in construction methods in brief. A few aspects of the subject are only dealt with.

Standardization in Building Construction

A. Suryanarayana

Non-member

Except for a few public buildings constructed by the various governmental or quasi-governmental agencies, municipalities, housing boards and corporations, the building industry has been the sole concern of individual citizens or entrepreneurs. An individual or a group of persons is allowed to have his/its design, plans and specifications without any reference to the overall functional utility and economy of such construction on a national level. Designs, plans and specifications of buildings constructed in the same locality, by the same class of people for the same purpose, differ widely from building to building. This results in overlapping, duplication, redundancy, wastage of material and low productivity of labour creates unhealthy competition and rise in prices and retards the pace of building construction in the country as a whole. This paper deals with the possible standardizations in building construction methods, materials, etc., for the maximum utilization of the resources.

Method of Execution of Works—1 : Departmental System ; and 2 : Cooperative Labour System

Maj. R. S. Thakur

Non-member

Most of the works in M.E.S. have been executed through enlisted contractors on the basis of lowest bidder getting the work. This system functioned satisfactorily in the pre-war period when the load of work was not sizable ; but throughout the war and subsequently, this system had to be reinforced by carrying out works by departmentally employed labour and specialized contractors/firms entrusted with special jobs on special rates of payment. In the present advanced stage of industrialization and rush jobs, the system has to mould itself to turn out jobs at a faster pace. This article attempts to provide a comparison of the various methods of execution of works from organizational point of view.

Cost Accounting in the Construction of River Valley Projects

Dr. K. C. Thomas

Member

and

N. Panchapakesan

Non-member

The capital outlay on irrigation and multipurpose river valley projects in the country, has been about Rs. 1,250 crores in the first two Five-Year Plan periods. About

Rs. 1000 crores is earmarked for similar projects in the Third Five-Year Plan. It has created an urgency to institute suitable cost control cells in all such projects, as well as in the planning departments, for carrying out continuous studies of performance and exercising progressive control on outputs and costs. However, the old methods of accounting procedures and controls have been found to be inadequate in the face of extensive mechanized construction procedures in river valley projects. This article reviews the peculiar characteristics of the modern projects and attempts to evolve a suitable cost control procedure for the same.

Ensuring Safety in the Construction of River Valley Projects

Dr. K. C. Thomas

Member

and

B. Sen

Associate Member

Numerous river valley projects, big and small, are under execution in various parts of the country. A large number of workmen, both skilled and unskilled, are employed on these projects. Due to the rapid tempo of the present day constructions, a large degree of mechanization and the use of electricity as motive power in many operations, the chances of exposure of the workman to hazards and accidents have increased considerably. For the safety of the workers, it is imperative that proper safety regulations are laid down for every phase of work and these are meticulously followed. Detailed instructions regarding the precautions to be followed in the civil engineering construction works of river valley projects are contained in a 'Safety Manual' recently published by the Central Water and Power Commission. A concise discussion of the various aspects is attempted in this article.

Hydraulic Similitude

M. M. Dandekar

Associate Member

The paper is divided into three parts. The first part discusses the basic principles of hydraulic similitude based on dimensional analysis. The second part considers various types of hydraulic models, the assumptions made in their construction, and the nature of the scale effects in them. The third part briefly reviews the laboratory technique developed to recreate simulation in the model.

STRUCTURES GROUP—2 : SHELL STRUCTURES

Continuous Northlight Folded Plate Roof for the Indo-Swiss Training Centre for Precision Mechanics, Chandigarh

G. S. Ramaswamy

Member

and

M. G. Tamhankar

Non-member

Northlight folded plates offer a very satisfactory solution for roofing factories demanding ample and uniform day-lighting. This paper reports a method of analysing continuous northlight folded plates developed as a result of the studies undertaken in connection with the design of northlight roofs for the Indo-Swiss Training Centre for Precision Mechanics, recently completed at Chandigarh.

An Approximate Bending Theory for Deep Shells

S. P. Sharma

Non-member

and

M. N. Keshava Rao

Non-member

Equations for the bending analysis of thin, deep shells are formulated in Cartesian coordinates to suit the boundaries occurring in practice. Blockskei's approach has been used and it is assumed that deformations are rapidly changing functions. Marguerre's equations are obtained from the general theory assuming shallowness. A simplified set of equations, obtained by neglecting third and higher powers of slopes, are also given for application to shells which are not too deep.

RAILWAY ENGINEERING GROUP

Development of Bogies for Railway Rolling Stock

P. C. Neogi

Member

The Indian Railways with a network of 35,000 track-miles in three gauges form the largest railway system in Asia. It handles a wide variety of freight traffic which is rapidly expanding with the increasing pace of industrialization and has risen from 114 to 168 million tons per year in the Second Plan, with an expected increase to 260 million tons after the Third Plan. In this paper, trends in the design and development of bogies for the railway rolling stock are given.

MECHANICAL ENGINEERING DIVISION

Automatic Inspection and Checking

K. N. Chakrabarti

Non-member

In the present trend of advancement of engineering and technology, mass production of identical parts plays an important role and as such inspection, checking and measurement of the products have become well defined marks of importance. In a mass production system, the parts produced must conform to the specifications previously established, so as to enable easy assembly, maintenance and replacement. There are many phases of inspection depending on the type of parts, *viz.*, inspection of quality, sizes, etc., which must lie within some specific tolerance zone. Thus control comes in the stage. Here attention is concentrated only to control through gauging, and automation in gauging will be the main point of discussion. The most common and widely used measuring instruments are micrometer and callipers. These are gauges with adjustable parts and hence are not very much convenient in mass production measurements. Fixed gauges are used widely in inspection causing lesser cost in manufacturing and assembly. However, automatic gauging has become very important. There are many methods of automatic gauging. In this article, pneumatic electrical and electronic methods of automatic gauging are discussed.

Automation of Metal Cutting Operations

A. K. Pal

Non-member

Automation in industrial production has evolved through the gradual replacement of human labour involved in the earlier mass production techniques by mechanical means. This article deals with several systems of automatic operations in the industries and attempts to review the wider impacts of the process of automation.

Automation and Its Impact on Productivity in Light Engineering Industries

K. C. Sahu

Non-member

and

S. K. Basu

Associate Member

Increase in the overall effectiveness of any productive unit requires, among other things, minimizing the ancillary elements of motion like transportation, in-line inspection, etc., by mechanization. Besides such mechanization, automation includes the sensing element, mostly in the form of a closed loop unit incorporating feed-back of information within the work-cycle. It is the sensing element that dictates and directs automatic action and control. In this article, some methods for automatizing the complete work-cycle in a light engineering industry are discussed with particular reference to the press shop. Methods suitable for automatising several elements in press shop work are dealt with.

NUCLEAR ENGINEERING GROUP

Steam Cycles Analysis for Nuclear Power Reactor

S. K. Biswas

Associate Member

Nuclear power stations are being erected in all the technologically advanced countries. To justify their growth, simultaneous efforts have been directed towards the improvement of the overall efficiency of power generation in the nuclear power stations. The improvement in efficiency will come not only through improved designs of nuclear power reactors but will also depend on the most efficient utilization of the heat produced in the reactor, in steam raising plants. This article describes various types of nuclear power reactors now under design, construction and operation, and analyzes the steam cycles for nuclear power plant.

BYE-LAWS*

of The Institution of Engineers (India)

incorporated by a grant of Royal Charter in the year 1935 for the general advancement of engineering science.

INTERPRETATIONS

1. In these Bye-Laws, unless the context otherwise requires, expressions shall have the same meaning as in the Charter, words importing males shall include females and words implying the singular number shall include the plural number, and *vice versa*, and words importing individual person or persons shall include body or bodies corporate.

Furthermore,

(a) 'The Institution' means The Institution of Engineers (India) incorporated by Royal Charter dated 9th September, 1935.

(b) 'The Charter' means the Royal Charter of The Institution dated 9th September, 1935.

(c) 'The Bye-Laws' means the Bye-laws of the Institution for the time being in force.

(d) 'The Council' means the Council of the Institution constituted under these Bye-Laws.

(e) 'The President' means the President of the Institution.

(f) 'Division Board' means the Board of a Division of the Institution.

(g) 'The Secretary' means the Secretary of the Institution as may be appointed by the Council from time to time.

(h) 'Financial Year' means the twelve months commencing the 1st day of September of a year and ending the 31st day of August of the following year.

(i) 'Session' means the period of time between the date of one Annual General Meeting and the date of the succeeding Annual General Meeting.

(j) 'The Roll' means the register of members of the Institution.

(k) 'Recorded Address' means the address of a member as given in the proposal for his election or transfer, or subsequently varied by notice in writing to the Secretary and as recorded in the Roll.

(l) For the purposes of these Bye-laws, a person shall be deemed not to have attained any particular age until the commencement of the corresponding anniversary of the day of his birth notwithstanding any rule to the contrary.

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* As adopted by Corporate Members in General Meeting at Calcutta on 19th October, 1963.

(m) 'Regulations' means the Regulations of the Council for the time being in force, made pursuant to Bye-law 72.

HEADQUARTERS

2. The Headquarters of the Institution shall be situated in Calcutta. The Headquarters may be shifted to any other place as may be decided by the two-thirds majority of Corporate Members on the Roll by postal ballot.

LOCAL CENTRES

3. The Council shall establish one Centre of the Institution in each State and Union Territory of the Indian Union referred to in these Bye-laws and to be known as Local Centre. This provision of one Local Centre in a State shall not, however, apply to the State where there are already in existence more than one Local Centre. Each Local Centre shall be constituted and its affairs shall be carried on in accordance with the provisions laid down in the Regulations and such other rules made from time to time by the Council.

4. The Council may establish one or more Sub-Centres of the Institution within the geographical boundaries of a Local Centre. The affairs of such Sub-Centres shall be carried on, and each such Sub-Centre shall have due representation in the Local Centre, in accordance with the provisions laid down in the Regulations and such other rules made from time to time by the Council.

MEMBERSHIP

5. The Institution shall consist of members in the following orders : Honorary, Corporate and Non-Corporate. The Honorary order shall comprise the classes of Honorary Members and Honorary Life Members. Corporate Members shall comprise the classes of Members and Associate Members and Non-Corporate Members shall comprise the classes of Companions, Affiliate Members, Graduates, Students and Subscribers. The names and addresses of all classes of members shall be entered on the Roll of the Institution.

MANAGEMENT

6. The Council shall exercise all the powers of the Institution and control, govern, do and discharge all the affairs and duties of the Institution with intent to give effect to the provisions of the Charter and the Bye-laws for the time being of the Institution except so far as the same are by the Charter or by the Bye-laws for the time being expressly required to be done in General Meetings of Corporate Members or by the President or the Secretary of the Institution. The Council shall be competent to make any delegation of its said powers or duties to the President or the Secretary.

DIVISIONS

7. The Institution shall have the following Divisions of Engineering for the advancement of the respective branches of engineering:

- (i) Civil Engineering Division
- (ii) Mechanical Engineering Division
- (iii) Electrical Engineering Division
- (iv) Mining and Metallurgy Division
- (v) Electronics and Telecommunication Engineering Division
- (vi) Chemical Engineering Division
- (vii) Public Health Engineering Division

8. The Council may establish, in addition to the Divisions mentioned in Bye-law 7, other Divisions for the advancement of any particular branches of engineering provided that Corporate Members not less than 500 in number specially qualified in any proposed new Division seek the establishment of such a Division. The Council may also abolish any Division if after five years from its establishment the number of Corporate Members in that Division is less than 300.

9. The existing Groups of Engineering and such other Groups of Engineering which the Council may establish shall work within the appropriate Divisions as may be decided by the Council.

10. Corporate Members and Graduates shall be attached to one Division only based on their educational qualifications approved by the Council at the time of their admission to the Institution, but if so qualified for attachment to more than one Division, a Corporate Member and a Graduate shall be allowed to select and change to the Division to which he would like to be attached. The Council may, however, at their discretion, allow the transfer of a Corporate Member or Graduate from one Division to another provided he establishes to their satisfaction that he deserves such transfer on account of change in the field of his practice of engineering subsequent to his election as a Corporate Member.

Corporate Members and Graduates may take part in the technical activities of one or more Divisions other than their own in accordance with rules made from time to time by the Council.

11. Companions, Affiliate Members, Students and Subscribers shall not be attached to any of the Divisions.

QUALIFICATIONS FOR MEMBERSHIP

Honorary Members

12. Honorary Members shall be the President of India, the Vice-President of India, the Prime Minister of India, and Governors of States or equivalent Heads of States as may be invited by the Council to be Honorary Members for the period of their tenure of office.

Honorary Life Members

13. Honorary Life Members shall be elected by the Council from persons in India and abroad for their high eminence in engineering or the sciences and every such election shall be announced at the next Annual General Meeting, provided that there shall not be more than fifteen Honorary Life Members at any one time. The Council shall frame rules for the election of such Honorary Life Members and in regard to the manner of bestowing the honour on them.

Members

14. Every candidate for election as a Member or for transfer from Associate Member to Member shall satisfy the Council that he possesses the following qualifications :

(i) Age : He shall have attained the age of thirty-five years on the date of his application for election or transfer.

(ii) Occupation : He shall be engaged in the profession of engineering in a position of high responsibility, or shall have retired from the profession after having held, before his application for election or transfer, a position of high responsibility.

(iii) Attainments : He shall have one of the following qualifications lettered respectively (a) or (b) or (c) :

(a) He shall either be an Associate Member or shall have fulfilled the conditions necessary for Associate Membership ; and he shall have had at least twelve years' employment in the aggregate in a position of responsibility in the design or execution of important engineering works.

For the purpose of this Bye-law, employment as a senior member of the engineering staff in an engineering college or institute which has regular courses of study leading to an educational qualification recognized by the Council as exempting from Sections A and B of the Associate Membership Examination, or employment in a responsible position on important engineering research may be accepted by the Council in place of employment in the design or execution of important engineering works.

(b) He shall have had at least fifteen years' employment in the aggregate in a position of responsibility as described in Bye-law 14 (iii)(a).

(c) He shall have high educational qualifications, and shall occupy a prominent position in the profession of engineering to the satisfaction of the Council.

Associate Members

15. Every candidate for election as an Associate Member or for transfer from Graduate or Student to Associate Member shall satisfy the Council that he possesses the following qualifications:

(i) Age: He shall have attained the age of twenty-five years on the date of his application for election or transfer.

(ii) Occupation: He shall have been engaged in a position of responsibility in the design and execution or operation of engineering works.

For the purpose of this Bye-law, employment as a teacher of engineering or in a likewise capacity in an engineering college or institute which has regular courses of study leading to an educational qualification recognized by the Council or employment in engineering research may be accepted by the Council in place of employment in the design and execution or operation of engineering works.

(iii) Examinations: He shall have passed Sections A and B of the Associate Membership Examination prescribed by the Council or possess an educational qualification recognized by the Council as exempting therefrom.

(iv) Training: He shall have received engineering training in a regular course of study in an engineering college or institute leading to an educational qualification recognized by the Council as exempting from Sections A and B of the Associate Membership Examination, or as a pupil or apprentice or assistant in an engineering office or works as would provide him with engineering training to the satisfaction of the Council.

(v) Experience: He shall have had further at least four years' professional engineering experience in a position of responsibility. In the case of a candidate who has passed Sections A and B of the Associate Membership Examination, the Council may, at their discretion, take into account periods of responsible employment prior to his passing Section B.

The Council may, at their discretion, arrange for candidates for election as Associate Members to be examined by a written or an oral test or both called Section C of the Associate Membership Examination in order that they may be satisfied that such candidates have acquired during their practical training and professional engineering experience adequate engineering knowledge.

Companions

16. Every candidate for election as a Companion shall have attained the age of thirty-five years on the date of his application for election. Not being an engineer by profession

he shall satisfy the Council that he occupies a position of high responsibility in a profession, science or industry having interests in relation to engineering, or has rendered important services to engineering.

Affiliate Members

17. Every candidate for election as an Affiliate Member shall have attained the age of twenty-five years on the date of his application. Not being qualified for Corporate Membership, he shall satisfy the Council that he holds a position of responsibility related to engineering.

Graduates

18. Every candidate for election as a Graduate or for transfer from Student to Graduate shall satisfy the Council that he possesses the following qualifications:

(i) Age: He shall have attained the age of twenty-one years on the date of his application for election or transfer.

(ii) Occupation: He shall be engaged in the engineering profession and shall, in the opinion of the Council, be making satisfactory progress in the acquisition of qualifications for Associate Membership, provided that temporary unemployment is no bar to his election.

(iii) Examinations: He shall have passed Sections A and B of the Associate Membership Examination prescribed by the Council or possess an educational qualification recognized by the Council as exempting therefrom.

(iv) Training: He shall have received engineering training in a regular course of study in an engineering college or institute leading to an educational qualification recognized by the Council as exempting from Sections A and B of the Associate Membership Examination, or as a pupil or apprentice or assistant in an engineering office or works as would provide him with engineering training to the satisfaction of the Council.

Students

19. Every candidate for election as a Student who has passed the Studentship Examination prescribed by the Council or possesses an educational qualification recognized by the Council as exempting therefrom shall have attained the age of sixteen years on the date of his application for election. He shall be qualifying himself for the profession of an engineer as a pupil or apprentice or assistant under a Corporate Member, or receiving training in an engineering college or institute leading to an educational qualification recognized by the Council, or obtaining training in any other manner approved by the Council. The Council may call for such reports from a Student in regard to the work in which he is engaged as they may consider necessary, and failure to submit such reports to the satisfaction of the Council shall be adequate reason to annul his election.

Subscribers

20. The Council may, at their discretion, attach to the Institution as a Subscriber any Public or Local Body, Registered Company or Firm, or an individual who may desire to be so attached.

ELECTION AND TRANSFER

21. Any person desirous of election as a Member or Associate Member or Companion, or transfer from Associate Member to Member, or from Graduate or Student to Associate Member, shall be proposed and recommended from personal knowledge in the prescribed form by six Corporate Members, of whom at least three shall be Members. The proposal form shall be accompanied by such fees as are prescribed in the Regulations, and shall be delivered to the Secretary.

22. Any person desirous of election as an Affiliate Member or Graduate, or transfer from Student to Graduate, shall be proposed and recommended from personal knowledge in the prescribed form by four Corporate Members, of whom at least two shall be Members. The proposal form shall be accompanied by such fees as are prescribed in the Regulations, and shall be delivered to the Secretary.

23. Any person desirous of election as a Student shall be proposed and recommended from personal knowledge in the prescribed form by two Corporate Members. The proposal shall be accompanied by such fees as are prescribed in the Regulations, and shall be delivered to the Secretary.

24. Any applicant desirous of attachment as Subscriber shall deliver his application direct to the Secretary, with such fees as are prescribed in the Regulations.

25. (a) On each proposal form from an applicant normally resident in India for Corporate Member or Companion or Affiliate Member, the Secretary shall record his opinion as to whether or not the qualifications of the candidate appear to be in accordance with the provisons of the appropriate Bye-law;

(b) The Secretary shall then forward the proposal form with his note aforesaid to the Honorary Secretary of the Local Centre within the boundaries of which the candidate resides or practices or carries on business;

(c) The Honorary Secretary of the Local Centre shall obtain the opinion of the Committee of the Local Centre, record it on the aforesaid note of the Secretary in the space set apart for this purpose, and return it to the Secretary;

(d) The Secretary shall then forward the proposal form to the President for his opinion, except when the opinion given by the Committee of the Local Centre is for election to the class of Member;

(e) If the opinion of the President agrees with the opinion of the Committee of the Local Centre, the Secretary shall then, on behalf of the Council, declare the proposal as approved by the Council or as not approved by the Council as the case may be;

(f) If the opinion of the President is not in accord with the opinion of the Committee of the Local Centre, the Secretary shall take a postal vote of the Council; in scrutinizing the result of the postal vote, one negative vote shall be taken as equivalent to two positive votes; except that in the case where the opinion recorded by the Local Centre is for election to the class of Member, votes cast for Associate Member shall be taken as negative votes, and in the case where the opinion recorded by the Local Centre is for election to the class of Associate Member, votes for Member shall be taken as positive votes; the Secretary shall then, on the result of the postal vote and on behalf of the Council, declare the proposal as approved by the Council or as not approved by the Council as the case may be; and

(g) Where the opinion recorded by the Committee of the Local Centre is for election to the class of Member, the Secretary shall also take a postal vote of the Council; and declare the result as in Bye-law 25(f).

. (a) On each proposal form from an applicant normally resident abroad for Corporate Member or Companion or Affiliate Member, the Secretary shall record his opinion as to whether or not the qualifications of the candidate appear to be in accordance with the provisions of the appropriate Bye-law;

(b) The Secretary shall then forward the proposal form to the President for his opinion, except when the opinion recorded by him is for election to the class of Member;

(c) If the opinion of the President agrees with the opinion of the Secretary, the Secretary shall then, on behalf of the Council, declare the proposal as approved by the Council or as not approved by the Council as the case may be;

(d) When the opinion recorded by the Secretary is for election to the class of Member, the Secretary shall take a postal vote of the Council; and declare the result as in Bye-law 25(f).

27. (a) Each proposal form for Graduate or Student shall be scrutinized by the Secretary as to whether or not the qualifications of the candidate are in accordance with the appropriate Bye-laws;

(b) The Secretary shall then, on behalf of the Council, declare the proposal as approved or not approved by the Council as the case may be;

(c) If the candidate has the requisite educational qualification but the nature of his training is such as can be best verified by the Local Centre within the boundaries of which he resides, the Secretary shall follow the procedure set out in Bye-law 25(a), (b), (c), (d), (e) and (f).

28. (a) Each proposal form for Subscriber shall be scrutinized by the Secretary as to whether or not it is desirable to attach the applicant as a Subscriber to the Institution;

(b) If the applicant, in the opinion of the Secretary, is suitable, the Secretary shall, on behalf of the Council, declare the proposal as duly approved by the Council, or if not suitable, as not approved by the Council.

29. Every candidate for the class of Member, Associate Member, Companion, Affiliate Member, Graduate or Student shall, on his election or transfer, be forthwith notified of the fact by the Secretary. But no person, although duly elected in accordance with the Bye-laws shall be entitled to any of the rights and privileges of the Institution, nor shall his name be entered on the Roll, until he shall have signed and delivered to the Secretary an undertaking in the prescribed form that he will be governed by the provisions of the Bye-laws and the Regulations in force from time to time and that he will accept as final and binding the decisions of the Council.

30. Every applicant for the class of Subscriber shall, on his attachment, be forthwith notified of the fact by the Secretary.

31. The Secretary shall give notice of every such election or attachment to the Honorary Secretary of the Local Centre within the boundaries of which the candidate or applicant resides or practises or carries on business.

EXAMINATIONS

32. The Council shall cause an Associate Membership Examination in Sections A and B to be held for election as Associate Members or Graduates and a Studentship Examination to be held for election as Students in the cases in which such examination is or may be required. Further, the Council shall also cause to be held Section C of the Associate Membership Examination for the purpose stated in Bye-law 15(v).

33. The Council shall frame rules for such examinations, define the times and places at which they shall be held, the subjects which they shall comprise, the fees to be paid by candidates in respect of such examinations, and the conditions under which the candidates may be admitted thereto. The Council shall have power from time to time to vary or rescind any such rules.

34. The Council shall cause an Examinations Committee to be appointed, and shall frame rules for the constitution and election of such a Committee, and shall define the powers and functions of the Committee. The Council shall have power from time to time to add to, vary or rescind any such rule.

35. The Council shall have power to recognize such university degrees and collegiate or other diplomas or certificates as after scrutiny they may deem to prove a sufficient standard of attainment in the subjects referred to; and may exempt such graduates or holders of such diplomas or certificates from passing in whole or in part the aforesaid examinations appointed and directed by the Council.

RIGHTS AND PRIVILEGES

36. Subject to the provisions of the Charter and to the restrictions contained in the Bye-laws:

(a) Members shall enjoy all the rights and privileges of the Institution, but in accordance with the provisions in the Bye-laws and the Regulations.

(b) Associate Members shall enjoy the rights and privileges of the Institution, but in accordance with the provisions in the Bye-laws and the Regulations and save that they shall not be eligible to hold office as President or Chairman of a Local Centre or Sub-Centre or Chairman of a Division.

(c) Companions, Affiliate Members, Graduates and Students shall enjoy the rights and privileges of the Institution, but in accordance with the provisions in the Bye-laws and the Regulations and save that they shall not be eligible to hold any office and shall not have any right of voting.

37. The rights and privileges of every Member, Associate Member, Companion, Affiliate Member, Graduate or Student shall be personal to himself as such and shall not be transmissible by his own act or by operation of law.

38. (i) Every Member and Associate Member is, and is entitled to describe himself as a Chartered Engineer, and in using that description after his name, shall place it after the designation of the class in the Institution to which he belongs, stated in accordance with the following abbreviated forms, namely, M.I.E., A.M.I.E.

(ii) A Member or Associate Member practising in partnership with any person who is not a Member or Associate Member under the title of a firm shall not use or permit to be used after the title of such firm the designation Chartered Engineer or Chartered Engineers, or describe or permit the description of such firm in any way as Chartered Engineers.

(iii) A Member or Associate Member practising or acting in a professional capacity under the title of, or as a director, officer or employee of a company, whether such company shall be authorized or not to carry on the profession or business of an engineer in all or any of its branches, shall not use or permit to be used after the title of such company the designation of Chartered Engineer or Chartered Engineers, or describe or permit the description of such company in any way as Chartered Engineers.

RESIGNATION, REMOVAL AND REINSTATEMENT

39. Every person elected to any class in the Institution shall be liable to the payment of his appropriate annual subscription until he shall have signified in writing to the Secretary his desire to resign, having previously paid all arrears including the current year's subscription, or until he has forfeited his right to remain in the Institution; provided that a letter of resignation may, with the consent of the Council, be cancelled at the request of the sender within six months of its receipt by the Secretary but on payment of all sums which he would have been liable to pay had his connection with the Institution not been interrupted. He shall thereupon recover all his former rights and privileges without re-election.

40. If any member of any class shall leave his subscription in arrear for two years, and shall fail to pay such arrears within three months after a notice has been sent to him by the Secretary, his name shall be removed from the Roll, and he shall thereupon cease to have any rights or privileges, but he shall nevertheless continue to be liable to pay the arrears of subscription due at the time of his name being removed from the

Roll. The Diploma or Certificate of every such person shall be returned to the Secretary.

41. The Council may, if they find good reason to do so, reinstate on such conditions as they may seem fit, any person who has been a Member or Associate Member and whose name has been removed from the Roll on account of resignation or non-payment of subscriptions. These cases shall be considered and reported upon to the Council by a Committee appointed by the Council for the purpose.

EXPULSION AND DISCIPLINARY ACTION

42. (i) The Council shall have the right to expel from the Institution any member who shall have, in the opinion of the Council, wilfully acted in contravention of the Charter or the Bye-laws or the Regulations from time to time in force under the Bye-laws, or who, in the opinion of the Council, shall have been guilty of such conduct as shall render him unfit to remain a member of the Institution, provided that:

(a) The meeting of the Council at which the resolution shall be passed shall be specially convened for the purpose, and the person concerned shall have been given clear thirty days' notice that his conduct is to be inquired into, and is given an opportunity of stating his case to the Council;

(b) The resolution shall be passed by a majority of two-thirds of those present.

(ii) Upon a resolution of expulsion being passed, the name of the person concerned shall be removed from the Roll and he shall cease to have any connection with the Institution. Neither the Council collectively nor any member of the Council individually shall be made liable for anything done under this Bye-law. Every candidate applying for election to the Institution shall be deemed in so applying to agree to accept as final any decision of the Council under this Bye-law.

(iii) Every person who has ceased to belong to the Institution shall be called upon by the Secretary to return immediately his Diploma or Certificate to the Secretary, and he shall not be entitled any longer to make use of any designation implying past connection with the Institution.

43. The Council shall also have the right to take any disciplinary action against any member who shall have, in the opinion of the Council, acted in such a manner as to warrant disciplinary action but not expulsion. The procedure laid down in Bye-law 42(i) (a) and (b) shall be followed in such cases also, and the decision of the Council shall be final.

THE COUNCIL

44. The Council shall consist of the President; the two immediate Past-Presidents; the Chairmen of the Local Centres; a Corporate Member from each of the Local Cen-

tres who shall be elected by the Corporate Members of the respective Local Centres; additional Corporate Members from those Local Centres whose Corporate Membership exceeds one thousand such that one additional Corporate Member is elected for every additional one thousand Corporate Members or less; three Corporate Members from each of those Divisions to which are attached 500 or more Corporate Members elected by the Corporate Members of the respective Divisions; and two Corporate Members from each of those Divisions to which are attached less than 500 Corporate Members elected by the Corporate Members of the respective Divisions.

45 The President shall retire at the Annual General Meeting of the Institution at the termination of his session of office but shall be eligible for re-election for a further period of office as President for one session only, but after completion of his periods of office (of one session or two sessions as the case may be) he shall not be eligible for re-election.

46. The Council shall elect the President from amongst members of the Council excluding the immediate Past-Presidents and the Chairmen of the Local Centres.

47. The President shall be *ex-officio* a member of all committees of the Institution.

48. In the event of the President being unable to perform the duties of his office due to death, resignation or any other cause, or in the case of his prolonged absence for any reason, the seniormost member of the Council shall assume all the duties of the President. The seniority of members of the Council shall be based upon the continuous number of years that the members concerned have been on the Roll as Corporate Members.

49. Members of the Council elected from the Local Centres and the Divisions shall hold office for a period of four sessions.

50. The Secretary shall, before the 31st August preceding each Annual General Meeting, notify the Honorary Secretary of each Local Centre of the number of members of Council who will retire at the Annual General Meeting, and shall call upon the Local Centre to hold an election under the appropriate Regulation to fill the vacancies in the Council.

51. The Council may fill by co-option any casual vacancy arising from death or resignation or any other cause of an elected member of the Council which may occur between one Annual General Meeting and the succeeding Annual General Meeting. The member of Council so appointed shall retire at the succeeding Annual General Meeting. Resignation from the Council, including resignation from Chairman of a Local Centre, shall become effective from the date of resignation, and shall not be withdrawn except by special permission of the Council.

52. If a Chairman of a Local Centre is already a member of the Council, then the Council may co-opt one Corporate Member from that Local Centre as a member of the Council during the period of office of the Chairman upon the recommendation of the Local Centre.

DIVISIONS

53. The affairs of each Division shall be carried on in accordance with the rules laid down from time to time by the Council. The Council shall have the power to vary the same as they may deem fit, subject always to the provisions of the Charter and the Bye-laws.

54. Members of the Council attached to a particular Division shall constitute the Division Board of that Division, and shall elect a Chairman from amongst themselves. If the number of members in any Division Board is less than three, then that Division Board may co-opt additional members to make up that number. Such co-opted members shall not, however, be members of the Council,

55. The Chairman of the Divisions shall hold office as Chairman for a period of two sessions.

56. Any casual vacancy of Chairman of a Division arising from death or resignation or any other cause which may occur between one Annual General Meeting and the succeeding Annual General Meeting, shall be filled by the Council.

SECRETARY

57. The Secretary of the Institution shall be appointed by the Council at such remuneration and on such other terms as they may think fit.

58. (i) The Secretary shall carry out all his duties under the direction of the Council. He shall, unless exempted from the provisions hereof by the Council, devote his whole time to the business of the Institution and shall not engage in any other business or profession. He shall be in administrative charge of all the employees at the Headquarters, Local Centres and Sub-Centres.

(ii) He shall be responsible for the conduct of all correspondence and office work of the Headquarters and the keeping of accounts of the Institution; he shall maintain a Roll of all classes of members and of their addresses; he shall attend all meetings of the Council and shall have the business thereat correctly and fully recorded and reported; he shall superintend the publications and the examinations of the Institution; he shall have charge of the libraries of the Institution; he shall have charge of all the properties of the Institution save only the funds and moneys in the custody of the Bankers; he shall engage, subject to the approval of the Council, all persons employed under him and arrange their work and duties; and he shall generally conduct the ordinary business of the Institution in accordance with the Charter, the Bye-laws, the Regulations and the directions of the Council, and shall refer to the President in any matters of importance or difficulty requiring urgent decision.

(iii) The powers of the Secretary shall be generally described in the Regulations, and may be varied by the Council from time to time.

BANKERS

59. The Bankers of the Institution and its Local Centres and Sub-Centres shall be the State Bank of India or one or more Scheduled Banks (as defined by Section 2 of the Reserve Bank of India Act of 1934) having head offices in the Indian Union as may be determined by the Council.

AUDITORS

60. (i) At each Annual General Meeting shall be appointed one or more properly qualified Auditor or Auditors to hold office until the next Annual General Meeting.

(ii) Every such Auditor or Auditors shall be a member of the Institute of Chartered Accountants of India, and shall hold a Certificate of Practice granted by that Institute.

(iii) The Council may fill any casual vacancy in the office of Auditor, but while any such vacancy continues the surviving or continuing Auditor or Auditors (if any) may act.

(iv) The remuneration of the Auditors shall be fixed at the Annual General Meeting at which they are appointed except that the remuneration of any Auditor appointed to fill any casual vacancy may be fixed by the Council.

POWERS, PROCEDURES AND DUTIES OF THE COUNCIL

61. Pending the election of a Council according to the provisions of these Bye-laws, the existing Council shall be the Council of the Institution and shall exercise all powers of the Institution subject to the provisions of the Charter.

62. The Council shall direct and manage the affairs and property of the Institution, subject to the provisions of the Charter, the Bye-laws and the Resolutions of General Meetings of Corporate Members which have been duly summoned and held in accordance with the Charter and the Bye-laws and duly recorded in the minutes of the meetings. Subject as aforesaid, the Council shall further exercise all powers of the Institution not otherwise specifically provided for, provided such powers are not by the Charter or the Bye-laws required to be exercised by the Corporate Members in General Meeting.

63. The decisions of the Council on all matters dealt with by them in accordance with the provisions of the Charter, the Bye-laws and the Regulations, and such Resolutions as aforesaid, shall be final and binding on all classes of members.

64. The Council may appoint Committees and may delegate any of their powers to any such Committees except as stated in Bye-law 65. The Council may, in addition, delegate any of their powers to the President, the Chairmen of Local Centres, the Chairmen of the Divisions, the Secretary or such other person or persons or bodies as they may appoint or constitute from time to time for the efficient working of the Institution. All Committees or persons, shall, in the exercise of powers delegated to them by the Council and in the transaction of business, conform to any direction that may be given to them by the Council and subject thereto may regulate their proceedings as they think fit.

65. None of the powers or functions of the Council under Bye-laws 42 and 43 shall, however, be delegated to a Committee save only the hearing of any explanation or defence given orally.

66. The Council shall meet as often as the business of the Institution may require, but not less than four times a year. At every meeting of the Council ten members shall constitute a quorum. A meeting of the Council at which a quorum is present shall be

competent to exercise all or any of the powers or discretions vested in or exercisable by the Council, notwithstanding any vacancy in the body. If at any meeting there is no quorum, the Council shall stand adjourned for twenty-four hours and shall meet at the same place and transact the business of the meeting, with the members present as the quorum.

67. To summon a meeting of the Council, the Secretary shall issue the notice of meeting to each member of the Council together with the agenda not less than fourteen days before the date of the meeting. This period of fourteen days shall be exclusive of the day on which the notice is issued, but be inclusive of the day for which the notice is given. This period shall not, further, apply to supplementary agendas which may be issued as the exigencies of the case may require, subject to the proviso that only such urgent matters as cannot wait till the succeeding meeting of the Council shall be included in them.

68. The Secretary shall summon a special meeting of the Council on receipt of a requisition in writing signed by at least ten members of the Council, and within 30 days of the receipt of the requisition. The notice of such special meeting shall state the purpose for which the meeting is called, and its period shall be the same as in Bye-law 67.

69. At any meeting of the Council, each member of the Council present in person shall have one vote. Except as provided in Bye-laws 42 and 43 all questions shall be decided in the Council by a majority of those present and having a right to vote. In the case of equality, the President or other person presiding shall have a second or casting vote. A postal vote of the Council shall, however, be taken whenever :

(a) any six present in person at the meeting shall demand it; or,

(b) any twelve, whether present at the meeting or not, shall by notice in writing delivered to the Secretary before the hour fixed for the meeting, demand it ; or,

(c) the meeting of the Council shall so direct;

70. The Council shall cause a statement of the funds of the Institution, and of the receipts and expenditure during the past year, terminating 31st August, to be made, and verified and signed by the Auditors. The Council shall cause such accounts to be presented at the Annual General Meeting.

71. The Council shall draw up an Annual Report of the Council on the state of the Institution, and shall present it at the Annual General Meeting.

72. The Council may make, amend or rescind Regulations but so that the same be not repugnant to the Charter and the Bye-laws, and provided that no such addition, amendment or rescission shall come into operation until the same has been approved by a Special General Meeting of Corporate Members.

73. The Council may, upon receipt of a request to that effect from any Society with objects kindred to those of the Institution, arrange for the amalgamation of such Society with the Institution, and may also extend such concessions as they think fit to members of such Society at the time of amalgamation to facilitate their admission into the Institution. But no such amalgamation shall be effective until it is sanctioned by a Special General Meeting of Corporate Members.

FINANCES

74. The revenue of the Institution shall form the general funds of the Institution and all its property, income and effects, of whatsoever kind, are vested in the Corporate Members as such Corporate Members for the furtherance of the objects of the Institution as defined in the Charter.

75. Under no pretence whatever shall any such property, income, revenue or effects of the Institution, derived howsoever, be paid or transferred directly or indirectly by way of dividend or bonus or otherwise by way of profit to the members of the Institution except in the case of and as a salaried officer or employee of the Institution. Provided always that nothing herein contained shall prevent—

(a) the payment by the Institution in good faith of reasonable and proper remuneration to any member of the Institution for any services rendered to the Institution;

(b) the payment by the Institution of interest on money lent to the Institution by any such member or reasonable or proper rent for premises demised or let by any such member to the Institution; or

(c) the giving by Institution to any such member of prizes, whether in cash or otherwise, and scholarships for the furtherance of the objects of the Institution.

76. The Council shall constitute a Finance Committee from amongst their members, and the strength of the Finance Committee shall not exceed five. Every vacancy that arises shall be filled by the Council by election from amongst their members.

77. All compounding fees, received from Members and Associate Members and all admission fees shall be regularly invested, as soon as possible after the receipt thereof by the Bankers, as instructed by the Council in any one or more of the securities appearing in the List of Securities hereinafter referred to as approved Securities appended to the Bye-laws, and only the interest accruing therefrom shall be available for the general expenditure of the Institution. Such moneys and investments shall form the Permanent Reserve Fund. The Council shall be at liberty:

(a) To vary the investments at their discretion within the limits of approved securities;

(b) To deposit all or any of the securities representing the Permanent Reserve Fund with the Bankers of the Institution to secure an overdraft on current account not exceeding Rs. 50,000 at any time; and

(c) To spend any portion of the Permanent Reserve Fund in purchasing land, buildings, furniture and equipment for the Institution or any Local Centre or Sub-Centre.

Save as aforesaid, no portion of the Permanent Reserve Fund shall be alienated without the consent of the Corporate Members, to be obtained by a postal vote, on which vote the majority shall be not less than three-fourths of the effective votes received.

The Council shall have the power to make from time to time such additions as they consider desirable to the Permanent Reserve Fund from the general funds of the Institution and the provisions of the Bye-laws shall apply to these additions exactly as if they had formed part of the receipts required by the Bye-laws to be invested for forming that Fund.

78. All the securities and moneys forming the assets of the Institution shall be lodged with the Institution's Bankers in the name of the Institution. Any surplus funds not required for the current expenditure and not carried by the Council to the Permanent Reserve Fund shall be invested from time to time by the Bankers, as instructed by the Council, in any one or more the securities appearing in the List of Securities appended to the Bye-laws as a Temporary Reserve Fund; and no securities forming part of this Fund shall be sold or otherwise disposed of except by order of the Council.

79. True accounts shall be kept of the sums of money received and expended by the Institution and the matters in respect of which such receipts and expenditure take place, and of the property, credits and liabilities of the Institution. The accounts of the receipts and expenditure shall be considered at regular intervals by the Finance Committee. The accounts shall be audited once annually by the Auditor or Auditors of the Institution. The Audited Accounts of the preceding financial year shall be presented by the Council for consideration and passing with the Annual Report of the Council at each Annual General Meeting and they shall comprise:

(a) a Balance Sheet, and

(b) separate accounts of endowments or trust funds created for specific purposes.

80. No payments from the moneys or funds of the Institution shall be made except under the express or implied sanction of the Council, and all cheques shall be signed by the Controller of Accounts and the Secretary or a member of the Finance Committee.

81. The names of all persons who have made any voluntary contributions to the funds of the Institution shall be enumerated in the Annual Report of the Council presented to the Annual General Meeting.

GENERAL MEETINGS

82. The General Meetings of the Institution shall be of the following classes:

(a) The Annual General Meeting of Corporate Members only, for the business prescribed in the Charter and the Bye-laws;

(b) Special General Meeting of Corporate Members for the purpose of

(i) considering making amendment or revocation of the Regulations made by the Council under the provisions of Bye-law 72;

(ii) considering any resolution duly passed by the Council and requiring the confirmation of the Corporate Members;

(iii) considering the specific matters to be moved at such Special General Meeting pursuant to any requisition signed by not less than one hundred Corporate Members and submitted to the Secretary.

(c) Extraordinary General Meeting of Corporate Members for the purpose of making, amending or rescinding any Bye-laws of the Institution.

83. The Annual General Meeting shall be held at such places as the Council shall determine but in the months of January or February in every year. But if not held due to unavoidable reasons, the Council shall have the power to hold the Annual General Meeting in any other month, and the reasons for the postponement shall be announced at the Annual General Meeting. Only Corporate Members shall be entitled to attend. The business of the Annual General Meeting shall be to receive the Audited Accounts of the Institution and the Annual Report of the Council for the preceding financial year and the report on the elections to the Council, and appoint Auditors and fix their remuneration.

84. Special General Meetings of Corporate Members shall be held at such places as the Council shall determine for the purposes stated in Bye-law 82(b). The requisition for the purpose of a Special General Meeting under Bye-law 82(b)(iii) shall be signed by at least one hundred Corporate Members and shall state the specific matters to be moved at such Special General Meeting and delivered to the Secretary. Upon receipt of such a requisition the Council shall be bound to call a Special General Meeting of Corporate Members, and shall cause the notice of the Special General Meeting to be issued within ninety days of the receipt of the requisition by the Secretary. At such Special General Meeting only the special matters of which notice has been given or such questions as necessarily arise thereof shall be considered.

85. An Extraordinary General Meeting of Corporate Members may be called at any time by the Council at such places as the Council may decide for the purpose of making, amending or rescinding any Bye-laws of the Institution. The Council shall be bound to call an Extraordinary General Meeting whenever a requisition signed by at least one hundred Corporate Members is made and delivered to the Secretary, specifying the additions, amendments or rescissions to the Bye-laws suggested by them, and shall cause the notice of the Extraordinary General Meeting to be issued within ninety days of the receipt of the requisition by the Secretary. These provisions shall not, however, apply to Bye-law 2 which shall be opertaed only according to its own provisions.

86. No new Bye-law, or rescission of any existing Bye-law, shall be proposed at any General Meeting of the Institution, except an Extraordinary General Meeting convened in accordance with the provisions of Bye-law 85.

87. Notice of the making, amending or rescinding of any Bye-law shall be published in the appropriate publication of the Institution as soon as it is reasonably practicable after the same shall have been passed in accordance with the provisions of the Charter and the Bye-laws.

88. At least twenty-five days notice shall be given of all General Meetings of Corporate Members. This period of twenty-five days shall be exclusive of the day on which the notice is deemed to be given but be inclusive of the day for which the notice is given. In the case of an Extraordinary General Meeting being convened for the purposes of of Bye-law 85, the instrument for appointing a proxy as described in Bye-law 95 shall accompany the notice.

89. Service of a notice shall be deemed to be effected by properly addressing, prepaying and posting the letter containing the notice. The accidental omission to give notice of a General Meeting of Corporate Members to, or the non-receipt of notice of such a meeting by, any Corporate Member entitled to receive notice shall not invalidate the proceedings of that meeting.

PROCEEDINGS OF GENERAL MEETINGS

90. No business shall be transacted at any General Meeting of Corporate Members unless a quorum is present when the meeting proceeds to business. The Corporate Members present shall be the quorum for the Annual General Meeting, fifty Corporate Members for a Special General Meeting, and one hundred Corporate Members for an Extraordinary General Meeting. If within thirty minutes after the time appointed for a Special General Meeting or an Extraordinary General Meeting, the requisite quorum is not present, the meeting shall be dissolved.

91. The President, when present, shall be chairman at all General Meetings, and in his absence the chair shall be taken by a member of the Council in order of their seniority. But if no member of the Council is present and willing to act, the meeting shall elect a chairman from the Corporate Members present at the meeting.

92. The Chairman may, with the consent of the meeting, and shall if so directed by the meeting, adjourn the meeting by twenty-four hours. The adjourned meeting shall be held at the same place, but no quorum shall be necessary and no business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which adjournment took place. It shall not be necessary to give any notice of an adjournment or of the business to be transacted at an adjourned meeting.

93. At all General Meetings of Corporate Members questions shall be decided according to the majority of votes properly given thereat by show of hands,

(i) unless a poll is, before or on the declaration of the result of the show of hands, demanded by at least ten Corporate Members present, provided no poll shall be demanded on the election of a chairman or on a question of adjournment;

In the case of an equality of votes the Chairman of the meeting shall both on a show of hands and at a poll, have a second or casting vote. The acceptance or rejection of votes by the Chairman shall be conclusive for the purpose of the decision of the matter in respect of which the votes are tendered:

(ii) unless instruments of proxy have been deposited with the Secretary in accordance with the provisions of Bye-law 96, in which case due account shall be taken of them.

94. Votes may be given at any General Meeting of Corporate Members either personally or by proxy. Each Corporate Member present in person or by proxy shall have one vote. No person shall be appointed a proxy to vote at any meeting who is not a Corporate Member entitled in his own right to vote at such meeting.

95. The instrument appointing a proxy shall be in writing under the hand of the appointer and shall as nearly as circumstances will admit be in the form or to the effect following :—

The Institution of Engineers (India)

I or

being a Corporate Member of the above Institution hereby appoint

of

or failing him of

as my proxy at the (Annual General Meeting, Special General Meeting or Extraordinary General Meeting as the case may be) of The Institution to be held on the day of 19 . and at any poll held in connection therewith.

As witness my hand day of 19 .

Signature..

Class of membership in I.E.I..................................

96. The instrument appointing a proxy shall be deposited with the Secretary not less than three days before the hour fixed for the meeting at which the person named in the proxy proposes to vote, but no instrument appointing a proxy shall be valid after expiration of three calendar months from its date

97. A poll shall be taken by means of postal voting papers and shall be a poll of all Corporate Members who at the time of despatch of such papers shall be entitled to receive notice of a meeting,

- (a) when expressly specified to be so taken in the Bye-laws;
- (b) when Corporate Members demand it under the provisions of Bye-law 93 (i);
- (c) when, in its opinion, the Council considers it in the interests of the Institution that an appeal should be made on any question to the whole body of Corporate Members.

The form and contents of the voting papers shall specify the subject matter to be voted upon and the date of return thereof, and shall be issued at least thirty days, exclusive of the day on which the papers are deemed to be issued but inclusive of the day of return, prior to the date of return.

NOTICES

98. A notice may be served by the Council or the Secretary upon any member of any class either personally or by sending it, whether as a separate communication or included in or with one of the publications of the Institution, prepaid through the post addressed to such person at his recorded address.

99. Any notice served or sent by post shall be deemed to have been served or delivered at the expiration of ninety-six hours after it was posted.

100. A member whose recorded address is not in India shall not be entitled to any notice, and all proceedings may be had and taken without notice to such a member in the same manner as if he had received one notice.

COPYRIGHT

01. Each paper presented to the Institution and accepted for reading or publication in full or in abstract shall be the property of the Institution. The Council, in such cases as they may think fit, shall have power to release or surrender the rights of the Institution in respect of any such paper or the copyright thereof.

INDEMNITY

102. Each member of the Council and the Secretary shall be indemnified out of the funds of the Institution and to such extent as the Council shall approve from and against such costs, charges, damages and expenses as he may sustain by reason of his acting in execution of the duties or powers imposed upon or given to him by the Charter or the Bye-laws.

103. Each member of the Council shall not be accountable and shall not incur any personal liability in respect of any loss or damage incurred through any act, matter or thing done, authorised or suffered, being done in good faith for the benefit of the Institution, although in excess of his legal power or incurred through any omission, error of judgment, or oversight on his part.

COMMON SEAL

104. The Council shall provide a Common Seal of the Institution. The Seal shall be in the custody of the Secretary and be affixed to such documents as in law are required to be sealed, but only in the presence of the President or a member of the Council. The Secretary and the President or a member of the Council shall sign every instrument to which the Seal of the Institution is so affixed.

INSTITUTION BADGE

105. The Council shall approve the design of a badge to be worn by all Corporate and Non-Corporate Members.

APPENDIX TO THE BYE-LAWS

List of Securities

Referred to in Bye-law 77 (Permanent Reserve Fund) and Bye-law 78
(Temporary Reserve Fund)

1. Debentures, stock or securities of the Central Government or of any State Government.

2. Debentures, stock or securities of a corporate body, both the principal whereof and the interest whereon shall have been fully and unconditionally guaranteed by the Central Government or State Government(s).

3. Debentures or other securities for money issued, under the authority of any Central Act or Act of a State Legislature, by or on behalf of any municipal body, Port Trust, City Improvement Trust or autonomous corporation.

INSTITUTION NOTICES

Symposium on 'Concrete Construction' at the 44th Annual Convention, Hyderabad, February 8 to 13, 1964

A Symposium on 'Concrete Construction' will be held during the 44th Annual Convention to be held in Hyderabad, February 10-11, 1964. A list of titles is given below to indicate the scope of the symposium. It is intended to cover all aspects of concrete construction excluding the design aspects of concrete structures. Members can write papers on any one or more of the subjects listed or any other allied subjects.

A. *Plain concrete*

1. Basic materials like cement and aggregates
2. Admixtures
3. Methods of mix design
4. Formwork
5. Machinery for making concrete in large quantities
6. Methods of compaction of concrete
7. Influence of temperature variations
8. Creep and shrinkage in mass concrete
9. Special concretes like prepakt, vacuum, light weight, heavy weight, fire-proof, sound-proof, etc.
10. Methods of curing concrete
11. Concreting under water
12. Research on concrete construction methods

B. *Reinforced concrete work*

1. Uses of different types and shapes of steel
2. Use of vibrators in heavily reinforced structures
3. Precast constructions
4. Joints, hingers and rockers
5. Pumped concrete
6. Construction of tall structures like chimneys, cooling towers, etc.
7. Construction of tunnel linings

C. *Prestressed concrete*

1. Different types of high tensile steel in prestressed work
2. Different forms of anchorages and relative merits based on their performance in structures already built
3. Continuity in prestressed concrete work
4. Composite constructions involving prestressed concrete
5. Loss of prestress and verification with the performance of structures built
6. Cracking of prestressed concrete structures, particularly at the anchorage zone.

D. *Description of structures constructed and/or in construction in India*

Complete papers (with necessary illustrations in original) may be sent to Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, Professor of Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12, before **December 31, 1963.**

Symposium on 'Small Scale Industries', Hyderabad, February 10, 1964

As notified on page 27 of the *Bulletin* dated October 1963, the symposium on 'Small Scale Industries' will be held in Hyderabad on February 10, 1964, at the 44th Annual Convention of the Institution. A note prepared by Shri V. Y. Kamat (*M.*) was printed in the same *Bulletin*. Papers are invited from members on any of the points suggested therein by **December 31, 1963.**

Subscriptions for 1963-64

Members are reminded that subscriptions for 1963-64 became due on September 1, 1963.

Members who have not yet sent their subscriptions for 1963-64 are requested to remit the subscriptions quoting their membership number at an early date. The rates of subscription are :

Members	.. Rs. 80.00
Associate Members	.. Rs. 50.00
Graduates	.. Rs. 40.00
Students	.. Rs. 35.00

Members who desire to remit subscriptions through the State Bank of India *must* enclose subscription Cards A and B.

After the subscription is deposited in a branch of the State Bank of India, Subscription Card A is returned to the members after being signed by the Bank official. Card A, after it is signed by the Bank official, should be retained by the member and *should not* be sent to the Institution.

Members remitting their subscriptions by money order *should not* send the original money order receipt to the Institution.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

Draft Indian Standard Methods of Measurement of Fluid Flow by Means of Orifice Plates and Nozzles—Doc ; BDC 17 (665).

This Standard details the recommendations for measurement of fluid flow by means of orifice plate or nozzle placed in a pipe line in the case of incompressible, single-phase flow. This standard also describes the shape and the methods of use of certain of these devices on which direct calibration experiments have been made to enable coherent systems of use to be based on their results.

Members may send their comments on the above draft Standard before January 31, 1964, to Dr. H. L. Uppal (*M.*), Director, Irrigation and Power Research Institute, Amritsar, Punjab, who is the Institution representative on the Sectional Committee dealing with this draft Standard.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/21 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

INSTITUTION NEWS

Opening of a new Sub-Centre at Neyveli

As approved by the Council in their 430th Meeting held in Trivandrum on August 24-25, 1963, a Sub-Centre of the Institution was opened at Neyveli, Madras State, on October 23, 1963. Shri R. R. Pillai (*M.*) and Shri V. A. Arthanoor (*A.M.*) were elected Chairman and Honorary Secretary respectively. The Sub-Centre was inaugurated by Shri C. Rajaram (*M.*), Head of the Mechanical Engineering Department, Annamalai University.

The Secretary of the Technical Club, Neyveli, read a report indicating the events leading to the formation of the new Sub-Centre of the Institution of Engineers (India) at Neyveli. Shri C. Rajaram delivered his opening address and appreciated the enthusiasm and interest of the members of the Technical Club at Neyveli in creating this Sub-Centre. He said that he was very happy to become a member of this Sub-Centre, and said that while he was member of the Madras Centre, he could not attend the meeting mainly because of the distance and expense. Now this will not arise as Neyveli is nearer to Annamalai Nagar. He told that the Neyveli Sub-Centre will become prominent, because professional engineers and university authorities are its members and can attend the meetings frequently.

The Secretary of the Club then proposed a vote of thanks to all the participants and the members from the Annamalai University. In his speech, the Secretary assured the members that he would strive his best to provide lively activities in the Sub-Centre and conduct the affairs of the Sub-Centre in best traditions of the Institution. He thanked the members for having elected him the first Honorary Secretary of the Sub-Centre. After the business meeting, a film show was arranged by the Technical Club.

Sale of British Standards

The Calcutta Branch Office of the Indian Standards Institution notifies that for the convenience of the local trade and industries, they have arranged for the sale of all British Standards in their office at 11 Sooterkin Street, Calcutta 13. In the case of Indian Standards, a special discount of 50% has been announced if indent for 1,000 or more Indian Standards is placed at a time, provided not more than one copy of any Standard is ordered.

World Space Communication Conference, Geneva, October-November 1963

The World Space Communication Conference convened by the International Telecommunication Union (ITU) which had been meeting in Geneva for five weeks since October 7, 1963 (reported in the *Bulletin* dated August-September 1963) has completed its work with the signing of the Final Acts.

The main task of the Conference, which was attended by more than 400 delegates from 70 ITU member countries, was the allocation of radio frequencies for outer space activities and the consequent revision of the Table of Frequency Allocations, which is the heart of the Radio Regulations, the basic document governing the operation of radio throughout the world, which was last revised by the Geneva Radio Conference of 1959. The allocation of an adequate number of frequencies for outer space has become an urgent task since then due to the rapid growth of activity in space.

The Conference finally allocated, on a shared or exclusive basis, frequencies totalling 6076.462 Mc/s for the various kinds of space services, 2,800 Mc/s of which are for communication satellites on a shared basis with other services. Thus, while at the 1959 Conference only about 1% of the frequency spectrum was made available for outer space, about 15% has now been made available.

The Conference also adopted a number of revisions and additions to other parts of the Radio Regulations, mainly concerned with general rules for the assignment and use of frequencies; notification and recording of frequencies in the Master International Frequency Register which is maintained by the International Frequency Registration Board (IFRB), a permanent organ of the ITU; the identification of stations; service documents; terms and definitions; and special rules relating to particular services. These revisions and additions were necessitated to make provison for the space services.

In addition, the Conference adopted a number of important resolutions and recommendations. One of these deals with the future action to be taken by the ITU in the light of future developments in space radiocommunications. Another recommendation was addressed to the International Radio Consultative Committee (CCIR) pointing out that 'the use of satellite transmissions for direct reception by the general public of sound and television broadcasts may be possible in the future' and urging the CCIR to expedite its studies on the technical feasibility of broadcasting from satellites. Thus, an important step has been taken towards the future possibility of the general public being able to receive radio and television programmes in their own homes direct from satellites. A further recommendation called on the forthcoming ITU Aeronautical Conference to provide high frequency channels (bands between 2,850 to 22,000 kc/s) for communications for the routine flight of transport airspace vehicles flying between points of the earth surface both within and beyond the major part of the atmosphere. Another recommendation recognizing 'that all Members and Associate Members of the Union have an interest in and right to an equitable and rational use of frequency bands allocated for space communications' and recommending to all ITU Members and Associate Member States 'that the utilization and exploitation of the frequency spectrum for space communication be subject to international agreements based on principles of justice and equity permitting the use and sharing of allocated frequency bands in the mutual interest of all nations' was also adopted.

One of the most important resolutions deals with space vehicles in distress or emergency, noting that the frequency of 20,007 kc/s had been set aside by the Conference for this purpose and resolving that for the time being the distress signal used by ships or aircraft (SOS in radio telegraphy and MAYDAY in radio telephony) should also be used by spacecraft.

FORTHCOMING CONFERENCES

Seminar on 'Industrial Research', Madras, January-February 1964

A seminar on 'Industrial Research' will be held in Madras during January-February 1964, under auspices of the Industrial and Scientific Research Association, Madras.

The seminar will cover a period of three days during which technical sessions will be held on the following subjects :

1. Electrical and Electronic Industries
2. Engineering Materials
3. Chemical and Pharmaceutical Industries
4. Natural Wealth and Its Industrial Possibilities
5. Science Teaching and Training for Industrial Needs.

A sum of Rs. 5.00 has been fixed as the delegate fee.

Further particulars can be obtained from the Convener, Seminar Subjects Committee, Industrial and Scientific Research Association, 44, Mount Road, Madras-15.

1964 Electrical Engineers Exhibition, London, March 18-25, 1964

The 1964 Electrical Engineers Exhibition will be held at Earls Court, London, from March 18 to 25, 1964. In 1964 it will be the world's only exhibition of its kind, but the admission of overseas exhibitors now promise a high standard of representation of the world's electrical industry which will, for the first time, be gathered under one roof. The opportunity for foreign participation has been accepted in such a measure that buyers from home and overseas will be able to compare and discuss a wide range of the world's most outstanding products. More than 540 exhibitors have taken stands, representing an increase of more than 26,000 sq. ft. display space.

Further details can be had from Stanley Futter, Piccadily House, 33 Regent Street, London, S.W.1.

Second International Conference on Water Pollution Research, Tokyo, August 24-28, 1964

The Second International Conference on Water Pollution Research will be held in Tokyo, during August 24-28, 1964. The Japanese Government will be the hosts. Sponsored by the Water Pollution Control Federation of the United States and its member organizations in other countries, it is expected that engineers and scientists from all over the world will attend the five-day series of meetings and seminars.

In preparing for the 1964 meeting in Tokyo, the Permanent Steering Committee of the Second International Conference has broadened the scope of the Conference and has established five objectives :

1. To provide a forum where reports on outstanding research in water pollution from all parts of the world may be presented, and to provide a medium for the publication of such reports;
2. To provide an opportunity for scientists engaged in water pollution research to meet and discuss matters of common interest;
3. To stimulate cooperation among nations in the conduct of research by identifying significant research needs of common interest;
4. To encourage newly developing nations to participate in conduct of research on water pollution problems; and
5. To promote international goodwill by providing scientists from many nations an opportunity to pool their research experience and knowledge in the solution of water pollution problems.

Further particulars can be obtained from the Water Pollution Control Federation, 4435 Wisconsin Avenue, N.W., Washington, D.C., U.S.A.

6th International 'Instruments and Measurements' Conference, Stockholm, September 14-19, 1964

The International Measurement Conference (IMEKO) will hold the 6th International 'Instruments and Measurements' Conference in Stockholm, Sweden, from September 14-19, 1964. At a preliminary meeting of the Permanent Preparatory Committee of IMEKO held in Stockholm during August 22-24, 1963, 123 papers received for presentation at the Conference were reviewed and 77 papers were accepted. These papers will be presented and discussed in four sections dealing with such general topics as metrology, instrument design and instrument electronics; while six specialized sections will deal with measurements in the field mechanics, electricity, thermodynamics physical chemistry, etc. Problems on measurement and automation will be discussed in a special section organized jointly with the International Federation of Automatic Control (IFAC).

Measuring instruments developed in scientific institutions will be shown simultaneously with the Conference at an Institutional Exhibition, while recent products of industrial firms from many countries will be exhibited at a commercial exhibition to be organized on the occasion of the Conference.

Further information on the Conference may be obtained from the IMEKO Secretariat, P.O.B. 3, Budapest 5, Hungary, or at the Swedish Conference Committee I & M., IVA, P.O.B. 5073, Stockholm 5, Sweden.

Correspondence concerning exhibition matters should be directed to AB Anders Beckman, Smalandsgatan 2, Stockholm, Sweden.

IGNORANCE IS NO EXCUSE

You may be an engineering student or working in an engineering department, knowledge of accouts is absolutely essential.

A TEXT-BOOK OF PUBLIC WORKS ACCOUNTS

by S. C. Dikshit, C.E.Hons., P.G.Dip., A.M.I.E., M.I.A.B.S.E., Executive Engineer with Foreword by Sri Jagdish Prasad, C.E., M.I.E., Chief Engineer, U.P., P.W.D. Second enlarged edition of the above popular publication is just out of press. It covers all important topics, e.g. new heads of accounts, cash, stock, T. & P., road metal, tenders, bills, rent statements, booking of expenditure, dealings with railways, T.A., Overseer's duties, book-keeping, etc., Contains many solved practical examples.

Covers the Syllabus of Diploma Courses of Bihar, Kashmir, M.P., Punjab & U.P. Highly useful for departmental examinations.

Some opinions about the book:—

"...... The book is well written and the subject matter properly arranged. The illustrations given therein are very useful." J. Mukund, Chief Engineer, P.W.D., H.P.

"........I find that it is a very useful work nicely brought out and will be of immense help to staff and officers in the P.W.D. and go a long way to minimise audit objections if properly made use of." Md. Usman, Addl. Chief Engineer, Hyderabed.

"..... ..I feel that it will be found very useful by new entrants to the P.W.D. as Overseers etc., in discharging their duties satisfactorily by avoiding the common irregularities usually committed in the maintenance of initial accounts." P. Sirajuddin, Chief Engineer, Madras.

" .. It is quite a nice book explaining the basic principals of P W. Accounting which is useful for all those who are engaged in Engineering activities and particularly for engineering students." K. M. Joshi, Chief Engineer, Mysore.

Price Rs. 10.50. Packing and postage extra. Descriptive literature free.

SUBODH AND COMPANY

286, KUTCHERY ROAD, LUCKNOW

(Our office has shifted from Roorkee)

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

YOUNG MECHANICAL ENGINEER, B Sc., LL.B., passed Sections A & B of the Institution of Engineers (India), age 27, having undergone a 5-year apprenticeship in a Railway Steel Foundry, with knowledge of labour and allied laws, seeks suitable appointment. (office ref. E.S. 141).

YOUNG ELECTRICAL ENGINEER, age 20, who holds First Class Diploma in Licentiate Electrical Engineering and stood second in the State Council for Engineering and Technical Education examination, Government of West Bengal, in June 1963, requires a suitable apprenticeship or employment in a factory near about Calcutta. Please contact Sukumar Datta, 26B Mitra Colony, Behala, Calcutta 34.

YOUNG ELECTRICAL ENGINEER, B.Sc (Engg.), A.M.I.E., with Supervisors Certificate of Competency covering all parts except mines; having 9 years experiences in layout design, erection and maintenance of H.T. lines substation equipments and maintenance of factory plant comprising mercury arc rectifiers, synchronous motor-generators, A.C. and D.C. motors with ancillary electrical equipment connected with various machine tool plant, power compressors, hydraulic plant, air-conditioning plant, overhead electric cranes, foundry plant including electrical arc smelting furnace, lifts etc., and a large pack of welding sets; at present drawing Rs. 950 in an old reputed industrial firm, seeks suitable change as Project Engineer or Electrical Engineer/Plant Engineer in factory, mills, tea gardens, etc. (office ref. E.S. 142).

THE INSTITUTION, ITS LOCAL CENTRES AND SUB-CENTRES

Headquarters

8 Gokhale Road, Calcutta 20.
P.O. Box No. 669

Telephone 47-4344 (2 lines) Telegrams ENJOIND

Local Centres

Andhra Pradesh	Khairatabad, Hyderabad-Dn. (*Telephone 33066*).
Assam	P.W.D. Secretariat (R & B), Shillong (*Telephone 47-2744*).
Bengal	8 Gokhale Road, Calcutta 20 (*Telephone 47-2744*).
Bihar	Huda House, Gandhi Maidan Road, Patna 1 (*Telephone 2539*).
Bombay	Ilaco House, Sir Pherozeshah Mehta Road, Fort, Bombay (*Telephone 26-3430*).
Delhi	Mathura Road, near Hardinge Bridge, New Delhi (*Telephone 272702*).
Gujarat	C/o Gujarat Institute of Civil Engineers and Architects Building, Law College Road, Ahmedabad 6.
Jammu & Kashmir	C/o The Principal, K. G. Polytechnic, Srinagar.
Kerala	12/33B Observatory Hill, Trivandrum (*Telephone 2663*).
Madhya Pradesh	C/o Government Engineering College Jabalpur.
Madras	Adam's Road, Chepauk, P.O. Triplicane, Madras 5 (*Telephone 85879*).
Mysore	Mysore Engineers Association Building, Bangalore (*Telephone 5471*).
Nagpur	North Ambazari Road, Nagpur 1 (*Telephone 5671*).
Orissa	3A Cantonment, Cuttack 1.
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Punjab	Thapar Institute of Engineering and Technology Building, Patiala.
Rajasthan	C 46, C-Scheme, Jaipur (*Telephone 3227*).
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Sub-Centres

Baroda	C/o Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Kala Bhavan, Baroda (*Telephone 2629*).
Bhilai	Welfare Building 2, Bhilai Steel Works, Bhilai.
Bhopal	C/o Shri D. Dhar, Transformer Engineering Department Heavy Electricals (India) Ltd., Bhopal.
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Durgapur	C/o Chief Electrical Engineer, Durgapur Steel Project, Durgapur.
Jammu	C/o Office of the Superintending Engineer, Electric Project and Planning Circle, Jammu.
Jamshedpur	C/o Technical Institute, N Road, Jamshedpur.
Kharagpur	C/o Department of Civil Engineering, Indian Institute of Technology, Kharagpur.
Nagarjunasagar	Hill Colony, P O. Vijayapuri North, Nalgonda District.
Neyveli	C/o Shri V. A. Arthanoor, Secretary, Technical Club, Neyveli Lignite Corporation Ltd., Neyveli.
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FORTY-FOURTH ANNUAL CONVENTION
HYDERABAD
FEBRUARY 8-13, 1964

Further to the announcement made in the *Bulletin* for November 1963, certain changes notified by the Andhra Pradesh Centre and additional information received in connection with programme of the Convention are given below.

(i) The Inaugural Session of the 44th Annual Convention will be held at 9.00 a.m. on Sunday, February 9, 1964, at **Rabindra Bharati, Saifabad, Hyderabad** ; and

(ii) For the convenience of outstation delegates, facilities for registration will be open from 9.00 a.m. on Sunday, February 9, 1964, at **Rabindra Bharati**

instead of at Gandhi Bhavan, Mozamjahi Market Road, Hyderabad, as announced in the programme printed in the above *Bulletin.*

(iii) The Seventh Sir Mokshagundam Visvesvaraya Lecture will be delivered by Dr. K. L. Rao on February 9, 1964, at 11.15 a.m., at **Rabindra Bharati, Saifabad, Hyderabad.**

Paper Meeting in the Hindi Section

A Paper Meeting will be held in the Hindi Section on Tuesday, February 11, 1964, from 9.00 a.m. to 1.00 p.m. Shri Brijmohan Lal (*M.*), Adviser, Hindi Section, informs that the following two papers will be discussed.

(1) 'Valuation of Immovable Property' by Vishwambhar Prasad (*A.M.*) (*Journal*, vol. 43, no. 5, pt. HI 1, January 1963) ; and

(2) 'Practice, Progress and Utilization Potential of Irrigation in India' by Baleshwar Nath (*M.*), (*Journal*, vol. 43, no. 12, pt. HI 3, August 1963).

Students' Session at the 44th Annual Convention, Hyderabad, February 8, 1964

As announced in the November 1963 issue of the *Bulletin*, the Students' Session—(1) General, and (2) Technical—will be held on Saturday, February 8, 1964, from 5.00 p.m. to 8.00 p.m.

Students intending to present papers at the Technical Session may send their contributions immediately to Major R. S. Attre, A.M.I.E., Organising Secretary, 44th Annual Convention, Andhra Pradesh Centre, The Institution of Engineers (India), Khairatabad, Hyderabad 4, or, put up their papers to the Chairman of the Students' Section.

Seventh Annual General Meeting of the Indian National Society of Soil Mechanics and Foundation Engineering, Hyderabad, February 8-9, 1964

The Seventh Annual General Meeting of the Indian National Society of Soil Mechanics and Foundation Engineering will be held in Hyderabad on February 8-9, 1964, concurrently with the Annual Convention of the Institution, to enable member-delegates to attend the important functions of this meeting also. The following papers published in the *Journal of the National Society of Soil Mechanics and Foundation Engineering* for January 1963, are included for discussion at the meeting.

1. 'Thixotrophy in Soil Mechanics' by T. K. Natarajan and R. M. Palit.
2. 'Sudden Volume Change on Saturation of a Soil of Non-Loessis Origin' by A. V. Vera.
3. 'New Development of Soil Testing Equipment for Highway Engineers' by T. W. Vanzelst.
4. 'A Simple arrangement for Loading Test in the Field' by I. S. Uppal, S. R. Bahadur and V. P. Malhotra.
5. 'A Simple Automatic Control for Measuring Pore Water Pressure in Soils' by R. L. Majol.
6. 'Seepage Through Permeable Foundations of Hydraulic Structures' by J. W. Martis and Muthukumaran.

Members may send written discussions on the above papers to the Secretary, Indian National Society of Soil Mechanics and Foundation Engineering, Curzon Road, New Delhi 1, and attend the meeting for participating in further discussion.

Programme of Paper Meetings and Symposium

The Paper Meetings in the Electronics and Telecommunication Engineering Division will be held on Thursday, February 9, 1964, and a Symposium on 'Automation and Control' on February 10, 1964.

The following additional papers will also be discussed at these meetings :

1. 'Current Controlled Bridge Oscillator' by T. S. K. V. Iyer (*Non-member*).
2. 'Simulation of Fourth Order System with Triple Lead by a Single Operational Amplifier' by L. K. Wadhwa (*Non-member*).
3. 'On Liapunov's Director Method' by R. H. Engelmann.
4. 'Synthesis of A. C. Lag Networks Using R. C. and Active Elements' by J. G. Advani (*Non-member*) and R. P. Jain (*Non-member*).
5. 'A Report on the Second Congress of the International Federation of Automatic Control' by Dr. T. Prasad (*Non-member*).
6. 'Backlash in Feedback Control System' by I. J. Nagrath (*Non-member*) and D. C. Suren (*Non-member*).

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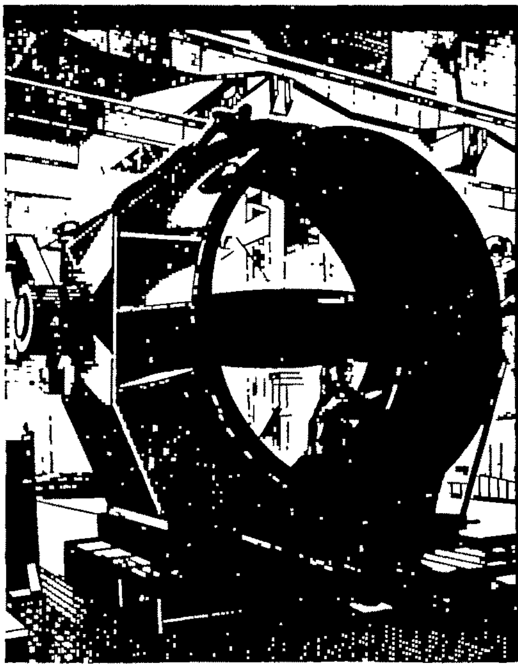

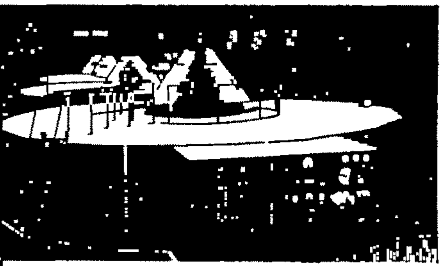

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THE BULLETIN
OF
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SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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ADVANCES IN INSULATOR-METAL SEALS

P. W. McMillan
Non-member
and
B. P. Hodgson
Non-member
Nelson Research Laboratories,
The English Electric Co. Ltd., England

Summary

Advances in electrical engineering and electronics have resulted in demands for improved techniques for sealing insulators, such as glasses and ceramics, to metals. This article surveys the existing techniques for glass-to-metal and ceramic-to-metal seals and describes a new process based on the use of glass-ceramics. These are materials which have outstanding mechanical and electrical characteristics, which are made by the controlled crystallization of special glasses.

The chief limitation of glass-to-metal seals is associated with the temperature to which they can be heated without distortion ; this places restrictions on the processing and operating temperatures. While brazed ceramic-to-metal seals overcome this limitation, they are difficult and costly to make. The basis of the new process is the preparation of a glass-to-metal seal by direct glass moulding using a special glass, followed by heat treatment to convert the glass into a glass-ceramic. To achieve this, new glass-ceramics which are stable in reducing atmospheres and which are matched in thermal expansion to a number of metals and alloys have been developed by The English Electric Co., Ltd. The process which is applicable to a wide range of seal designs using a variety of metals is illustrated by detailed description of the preparation of glass-ceramic seals to copper and mild steel. The properties of typical glass-ceramics for sealing to these metals are given.

The new process exploits the convenient and economic sealing properties of glasses and eliminates the lengthy processing involved in the manufacture of brazed ceramic-to-metal seals. At the same time, it provides insulator-metal assemblies of high mechanical strength, having good electrical characteristics and capable of withstanding high processing and operating temperatures.

1. Introduction

In the electronics and engineering fields there, are many instances where it is necessary to bond an insulating material such as a glass or a ceramic to a metal component which serves either as a structural member or as a conductor. The rapid pace of advancement in these fields has meant that increasingly stringent demands are placed on insulator-metal seal systems. The requirements include : increased mechanical strength to permit the use of lighter components, improved electrical insulation characteristics both at power frequencies, and very high frequency, and enhanced resistance to high temperatures to enable devices to be operated or processed under more rigorous conditions. While some of these requirements can be met by existing or improved versions of conventional glasses or ceramics, the development of glass-ceramics made by the controlled crystallization of special glasses has created new possibilities of insulator-metal seals. The indications are that such seals could be technically superior to many existing systems and that economies of production would result from the use of glass-ceramic sealing techniques. The object of this survey is to discuss the limitations of the existing techniques and to describe new types of insulator-metal seals which utilize special glass-ceramics developed by the Nelson Research Laboratories for this purpose. The new glass-ceramics are closely matched in thermal expansion coefficient to a number of useful metals and alloys, and they retain their outstanding electrical and mechanical characteristics during the sealing process.

Broadly speaking, the techniques used at present for the manufacture of insulator-metal seals fall into two categories depending on the nature of the sealing medium : glasses and braze metals are both widely used as sealing media and both have distinct advantages and limitations.

2. Glass-metal seals

Glasses may be used in a number of ways in the construction of seal assemblies. A large number of devices are enclosed in an envelope of glass through which metal leads are sealed or to which metal electrodes in the form of discs, rings or tubes may be joined by locally heating the sealing area of the glass envelope to a plastic state in contact with the metal component. A wide range of electronic valves are obvious examples of glass-metal seals of this type of construction. Other types of construction employ the glass solely as a bonding agent, generally between ceramic and metal parts to the mating surfaces of which the glass is applied as a thin layer. The envelope proper is then formed by jigging the preglassed ceramic and metal parts in the correct relationship and heating the assembly to soften the glass and to seal together the component parts through a thin interfacial layer of glass.

One important limitation of glass-metal seals is the temperature to which the seal assembly can be heated without causing softening of the glass. Generally speaking, the viscosity of conventional sealing glasses at temperatures approaching 500°C. falls to values which are not consistent with mechanical rigidity. The thermal expansion coefficients of more refractory sealing glasses are low and this prohibits their use with metals other than molybdenum and tungsten. The range of thermal expansion coefficients of normal sealing glasses is approximately 30×10^{-7} to 110×10^{-7} per °C., which restricts the number of metals which can be used. For instance, no satisfactory chemically stable glasses (or, ceramics) which have expansion coefficients matched to that of copper have so far been produced. The use of this important metal in vacuum seals is therefore limited to thin sections such as wire and foil. Finally, the mechanical robustness of glass envelopes may sometimes be inadequate.

3. Ceramic-metal seals

Brazed ceramic-metal seals were first developed in Germany, and during the Second World War, seals of this type were manufactured on a large scale by Telefunken A.G. The vital step in the preparation of brazed ceramic-metal seals lies in the proper metallizing of ceramic surfaces, permitting the high temperature brazing of bulk metals to them. This was first achieved by the Telefunken process and represented an outstanding advance. In general, ceramic-metal sealing is a multi-stage process of metallizing followed by brazing. Metallizing according to the Telefunken process is achieved by coating the ceramic sealing faces with a paste of molybdenum powder containing a small percentage of iron powder. The ceramic is then fired in hydrogen at about 1,400°C. or just below the softening point of the ceramic to sinter the powder and bond it to the ceramic. Variations of this basic process, particularly with regard to the composition of the metallizing mixture, are possible. The more recent active metal process involves coating the sealing faces with a metallic hydride and firing in an atmosphere of argon or under vacuum to temperatures above 1,000°C. Metallic titanium is produced during the firing which reacts with and bonds to the ceramic.

It is not easy to braze directly to these layers, and nickel is generally applied to them by electroplating or by a firing-on process. The latter involves coating the surfaces with fine nickel powder and firing in hydrogen at temperatures between 1,100° and 1,200°C. Actual union between the ceramic and metal faces is then achieved by a conventional furnace brazing technique using either copper, silver or a copper-silver alloy as the braze metal. Lower melting point braze metals and even solders can of course be used.

The reduction of strain by the yielding of the braze metal in brazed seals makes the limitations on the thermal expansions of the ceramic and the metal less stringent than for seals involving glasses. Nevertheless, it is necessary to use metals and ceramics of comparable thermal expansions to limit the stresses developed during cooling to safe limits. For this reason, the absence of any suitable ceramics with thermal expansion coefficients in the region of those of mild or stainless steel or copper limits the choice of metals available for sealing to those with thermal expansion coefficients lower than 130×10^{-7} per °C.

The chief disadvantage associated with the use of brazed ceramic-metal seals, however, is the lengthy processing which is necessary. The manufacture of the ceramic components themselves is lengthy, and due to normal linear shrinkages of 10-25% which occur during firing, the components cannot be made to close tolerances. Subsequent grinding to final dimensions is therefore necessary and often costly. The success of the metallizing process, particularly in the case of ceramics containing high proportions of alumina, depends to a large extent on the use of high temperatures and precisely controlled furnace atmospheres. After metallizing the ceramic parts, two further stages are normally necessary in the manufacture of ceramic-metal seals. These are the application of a nickel layer to the metallized ceramic and the final brazing process.

4. Limitations of existing techniques

Obviously, both types of seal have significant advantages and disadvantages. In the case of glass-metal seals, the ease of manufacture is probably the most important. Glass is easily blown or pressed into a variety of shapes by high speed machines and this makes glass blanks readily available at low cost. The ease with which molten glasses react with and bond to metals, or rather to metal oxide layers on their surface, permits the use of relatively low temperatures and makes the use of carefully controlled atmospheres unnecessary. Envelopes using glass as insulator as opposed to ceramics are much easier to evacuate to low pressures. This is believed to be due largely to the nature of the surfaces of the two materials. Glasses have much smoother surfaces which are free from microscopic surface fissures. This is probably not the case with ceramics.

The slow increase in viscosity which occurs when glasses are cooled from the liquid state demands the use of a temperature for vacuum bake-out at least 300°C. below the original sealing temperature. On the other hand, braze metals have fairly sharp melting points, and seals incorporating them can be heated to temperatures within a few degrees of the original brazing temperature for vacuum bake-out. The ability to out-gas ceramic-metal envelopes at higher temperatures is a definite advantage where high vacuum is required. Finally, the mechanical robustness of envelopes made using brazed ceramic-metal seals is greater than for envelopes constructed using glass as the insulator. This in part is due to the high tensile strengths of many ceramics, particularly those containing high proportions of aluminium oxide. Ceramic vacuum tube components usually have a much greater wall thickness than glass envelopes, due to the relative difficulty in accurately manufacturing thin walled ceramic articles, and this also plays its part in increasing the mechanical strength of ceramic-metal envelopes.

5. Glass-ceramics

The foregoing analysis of sealing techniques normally used in the construction of metal-insulator seal assemblies shows that each system has associated advantages and disadvantages. It is clear therefore that the development of a sealing technique which exploited the good features of ceramic-metal seals and glass-metal seals but which eliminated their undesirable features would be rewarding, and it was considered that glass-ceramics would provide the key to this development.

Glass ceramics have attracted world wide attention since their disclosure in 1957 by Corning Glass Works of America, because of their outstanding properties and potentialities, and since then, work carried out in a number of research organizations has expanded the knowledge of these materials. Work carried out in the Nelson Research Laboratories has led to the development of new glass-ceramic compositions which are particularly suitable for sealing to metals. The process involved in their manufacture is one of catalysed crystallization in which glasses which are not readily crystallized are made to crystallize by the use of a catalyst or nucleating agent. The purpose of the nucleating agent is to produce within the body of the glass many small particles of a minor component of the glass, which form nucleation sites for the growth of crystals of the major components of the glass during heat treatment. The general process for the manufacture of glass-ceramics is applicable to a wide range of glass compositions using any one of a number of nucleating agents such as titanium dioxide and phosphorus pentoxide, and metallic gold, silver and copper.

The first stage in the manufacture follows normal glass melting techniques but differs in that a relatively small proportion of a nucleating agent is included with the glass making raw materials. The molten glasses are then shaped by the normal methods of blowing, pressing, drawing and casting to form articles which may be annealed and cooled to room temperature or transferred direct to a heat treatment furnace for conversion to the crystallized form. This is achieved by holding the temperature of the glass at the nucleation temperature to promote the development of nuclei throughout the glass ; the temperature is then raised to the final crystallization temperature which is held until crystallization is sufficiently complete.

The outstanding characteristic of glass-ceramics is their microstructure which shows an absence of pores or voids and which is made up of many extremely small, randomly orientated interlocking crystals whose size range is below that of crystals found in normal ceramics. These features dictate to a large extent the properties of the materials, particularly their high mechanical strengths and resistance to impact and abrasion. Glass-ceramics are also characterized by high dielectric breakdown strength, low dielectric losses over a wide frequency range and high electrical resistivities, which, with increasing temperature, do not deteriorate as markedly as for glasses. The crystal types which can be formed in glass ceramics are numerous and depend primarily on the composition of the parent glass and also to some extent on the heat treatment. For this reason, glass ceramics can be made with a wide range of thermal expansion coefficients ranging from quite high negative values to values close to 200×10^{-7} per °C. Comparison of the softening temperature of most glass-ceramics with that of the parent glass shows that a gain in refractoriness of from 200° to 500°C. is generally achieved by conversion to the crystalline state.

6. Sealing of glass-ceramics to metals

It is found that the unique characteristics of glass-ceramics can be used with advantage to prepare seals to metals by a rapid and economic method which overcomes most of the disadvantages involved in the preparation of brazed ceramicmetal seals. The process involves the initial preparation of a glass-metal seal by direct moulding and this is followed by heat treatment of the seal assembly to convert the glass to a glass-ceramic.

Glasses containing a special nucleating agent are prepared by melting the necessary raw materials in the correct proportions at temperatures between 1,200° and 1,400°C. depending on the glass composition. The fuels and the furnace used for the melting process are those which are conventionally used for normal glasses ; sophisticated refactories to contain the molten glass are not required.

The pretreatment applied to the metal components varies for different metals, but in all cases, the aim is to achieve the maximum glass to metal adhesion during sealing and subsequent heat treatment. For metals such as certain nickel-iron and chrome-iron alloys which form adherent oxide coatings, only light pre-oxidation of the metal components is necessary. In other cases, a thin layer of another metal is applied to the sealing faces of the metal components, followed by a controlled oxidation procedure.

The metal components for the seal assembly are preheated to temperatures between 500° and 700°C., the actual temperature used depending on the thickness of the metal. The metal components are then arranged as required in preheated mild steel or cast iron moulds coated with a suitable parting agent such as colloidal graphite. The working temperature of the glass shaping moulds lies generally between 400° and 500°C. For the design of seals in which the size of the metal components is small, it is necessary to continue preheating them in the mould until just before the introduction of the molten glass. For other types, it is possible to design the mould such that the entire preheating cycle is carried out with the metal components positioned in the mould in the correct relationship to each other. In all cases, however, for successful sealing, it is essential that the metal components should be at a sufficiently high temperature when contacted by a molten glass to permit good 'wetting' of the metal by the molten glass. A charge of molten glass is then placed in the mould and pressed to the required shape by a hydraulically operated plunger. During this operation, the molten glass is pressed in contact with the metal part or parts and therefore shaping and sealing of the insulator is conveniently achieved in one simple operation (*vide* Fig. 1).

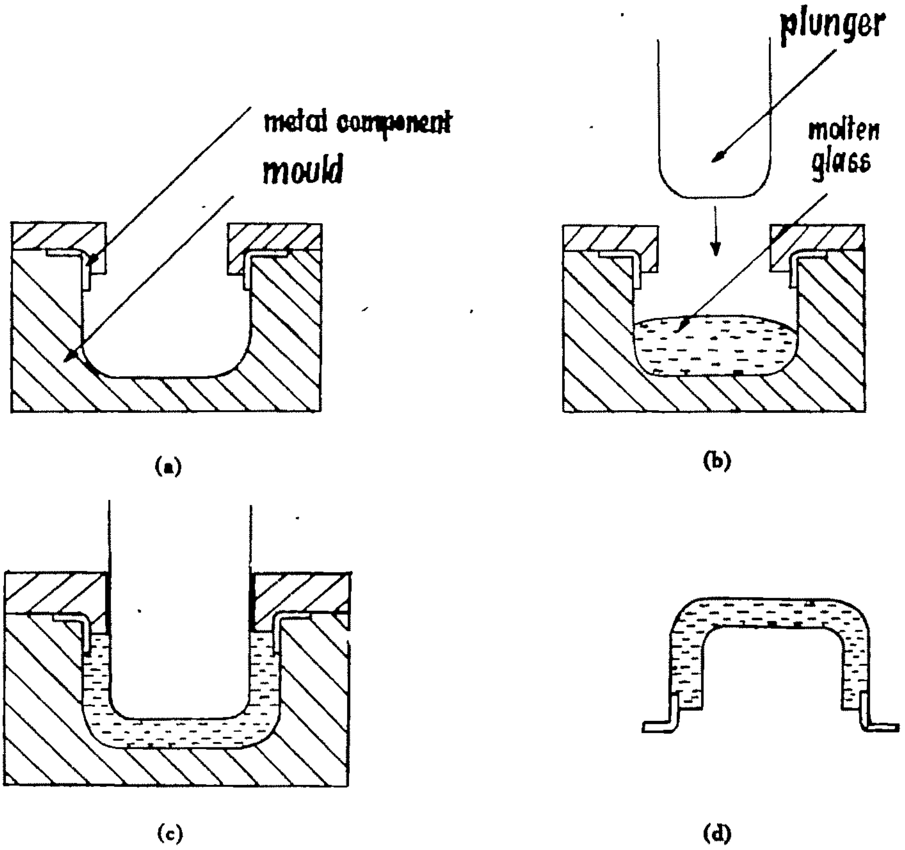

Fig. 1

Direct moulding of insulator-metal seals

(a) Mould with metal components in position; (b) Molten glass in mould: plunger descending; (c) Glass pressed and seal formed; and (d) Completed article

The glass-metal seal assemblies are allowed to cool in the moulds until the glass is sufficiently rigid to resist deformation on removal from the mould and transfer to the heat treatment furnace. The temperature of the glass at this stage is not allowed to fall to such a value that the glass becomes viscous enough to support appreciable stresses.

Conversion of the glass component of the assemblies to a glass-ceramic is achieved by first holding the seals at a temperature which is approximately 50°C. above the strain point of the glass. At this stage, nucleation of the glass occurs and crystals start to form around the nuclei, so that during subsequent heating, the skeleton of crystals so formed is sufficiently rigid to prevent the glass deforming. Heating is continued to the final crystallization temperature which is usually held for one hour and generally falls within the temperature range from 700° to 900°C. depending on the glass composition. During this stage of the process, crystallization proceeds rapidly and a dense ceramic product containing closely interlocking crystals is obtained. The cooling rates used depend largely on the design and size of the sealed assemblies, but in all cases, the rate is less than that which will cause the development of dangerously high stresses due to temperature gradients. In certain cases, the heat treatment can be carried out in air but in others, to protect the metal parts from excessive oxidation, furnace atmospheres of nitrogen or nitrogen-hydrogen mixtures are used. In this case, it is obvious that the constituents of the glass-ceramics should not include any which suffer damage, such as reduction of metallic oxides to the metals, during heat treatment in these atmospheres and this is a special feature of the glass-ceramics developed in the Nelson Research Laboratories.

It is clear that the basic process outlined in the foregoing paragraphs achieves a number of important objectives. Firstly, it provides a rapid method of manufacturing seal assemblies which can withstand temperatures of 700°C. or more for subsequent processing without resorting to excessively high temperatures during manufacture. In general also, the mechanical and electrical properties of glass ceramics are comparable with those of high grade ceramics, and for this reason, the properties of the seal assemblies are equivalent to those of brazed ceramic-metal seal assemblies. Secondly, the process eliminates the lengthy manufacture of brazed seals by exploiting the convenient and economic forming and sealing properties of glasses. Lastly, although not least in importance, the process is applicable to many designs of seal assemblies using a wider range of metals and alloys than was possible previously.

To illustrate these points more fully, two particular seal assemblies which have been made by this process will be considered in more detail. Fig. 2 shows a post or stand-off insulator consisting of two ½ in. diameter threaded mild steel studs which are sealed to a depth of 1 in. in a glass-ceramic cylinder (1⅛i n. diameter×4 in. long). Fig. 3 shows small glass-ceramic to copper vacuum envelopes.

Obviously, different glass-ceramics are required for sealing to mild steel and copper, but in both cases, the glasses are prepared by melting normal glass making oxides at temperatures between 1,300° and 1,400°C. Mild steel studs are normally sand-blasted prior to sealing, while the copper parts are specially pre-treated and pre-oxidized. The mild steel studs are preheated using suitable gas burners ; the copper parts are preheated in a furnace. The object in both cases, however, is to ensure that the temperature of the components is between 600° and 700°C. when contacted by the molten glass during the shaping operation. Both seal assemblies are prepared by normal glass pressing techniques using moulds in which the copper or mild steel parts are located. Heat treatment of the glass-metal seal assemblies to promote crystallization involves

Fig. 2
Glass-ceramic insulators with sealed-in mild steel fixing studs

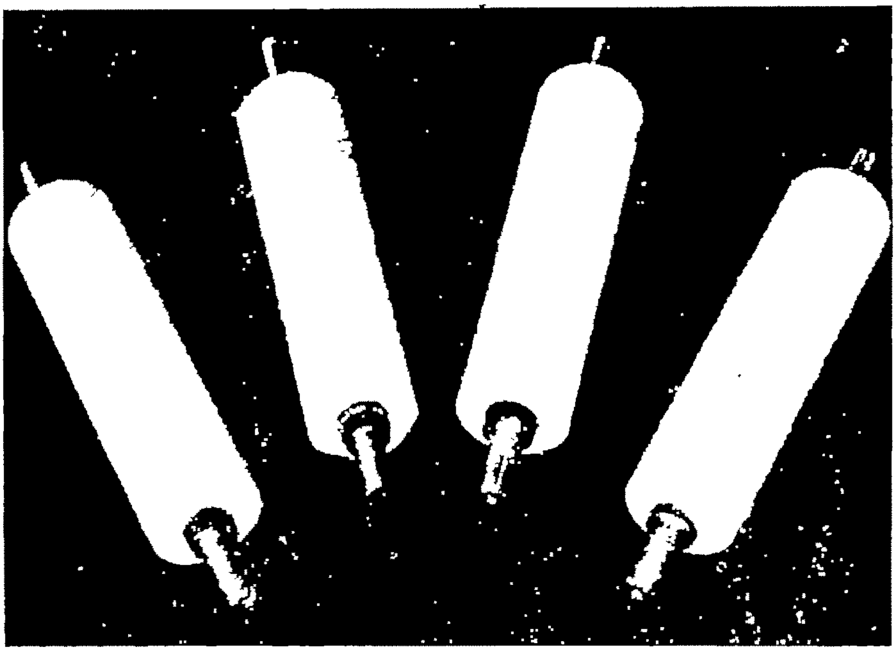

Fig. 3
Glass-ceramic to copper vacuum envelope

nucleation temperatures between 450° and 500°C. and a final crystallization temperature of 800°C. in the case of the mild steel seal and 725°C. in the case of the copper to glass-ceramic seal. It is not necessary to use any additional support such as moulds for glass-ceramic parts of either assembly during heat treatment, since conversion to the refractory crystalline state is achieved without any noticeable deformation of the glass-ceramic parts.

The thermal expansion characteristics of glass-ceramics which are normally used for sealing to mild steel and copper are plotted in Figs. 4 and 5 together with those of the appropriate metals. After heating to 725°C., the copper parts of the assemblies are in an annealed condition and the metal is therefore relatively soft. This allows some stress relief to occur due to plastic deformation of the copper, and for this reason, the closeness of the match between the thermal expansion coefficients of copper and the glass-ceramic is not so critical as for a number of other metals. By the selection of glass-ceramics with suitable characteristics and by the use of the optimum seal designs, the stresses which inevitably arise due to differential contraction in any seal system are kept to safe limits and potentially dangerous tensile stresses are restricted to less critical locations in the seal assemblies.

Some of the properties of a typical glass-ceramic (A) used for sealing to mild steel and that used for sealing to copper (B) are given in the table below. The mechanical strengths of the materials as shown by the modulus of rupture figures are at least twice that for most sealing glasses and are similar to the values obtained for high alumina ceramics. The softening temperatures, which are the temperatures which the materials will withstand without deformation under the action of light loads, show a gain in refractoriness on conversion from the glass to the crystalline states of approximately 350° and 250°C.

Properties of typical glass-ceramics for sealing to mild steel and copper

Property and units	Glass-ceramic A	Glass-ceramic B
Density, gm. per cm.^{3}	2.52	3.14
Modulus of rupture, lb. per sq. in.	40,000	35,000
Young's modulus, lb. per sq. in.	13.1×10^6	11.5×10^6
Thermal expansion coefficient (20°-600°C.), cm. per cm. per °C.	140×10^{-7}	178×10^{-7}
Softening temperature, °C.	850	750
Dielectric breakdown strength, kV per mm.	47	30
Permittivity at 1 megacycle	5.0	5.8
Loss angle (tan δ) at 1 megacycle	0.0023	0.0003
Volume resistivity at 20°C., ohm.-cm.	3.2×10^{15}	1.9×10^{15}

The high dielectric breakdown strength at 50 cycles of the two materials and the low dielectric loss at 1 megacycles of glass-ceramic B are also significant features.

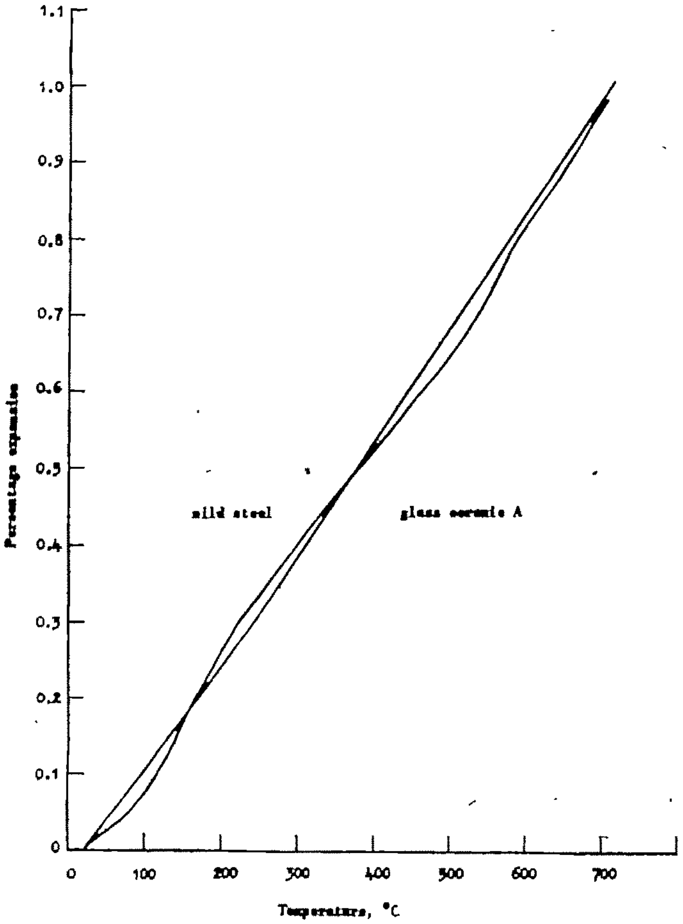

Fig. 4

Thermal expansion characteristics of mild steel and glass-ceramic A

In conclusion it can be said that the new process for sealing insulators (glass-ceramics) to metals provides a useful and significant alternative to conventional sealing process using either glasses or braze metal.

The important features of the process are (i) in general, it eliminates the undesirable features of glass and braze metal seals, and (ii) it is based on the use of glass-ceramics which have outstanding properties for many applications.

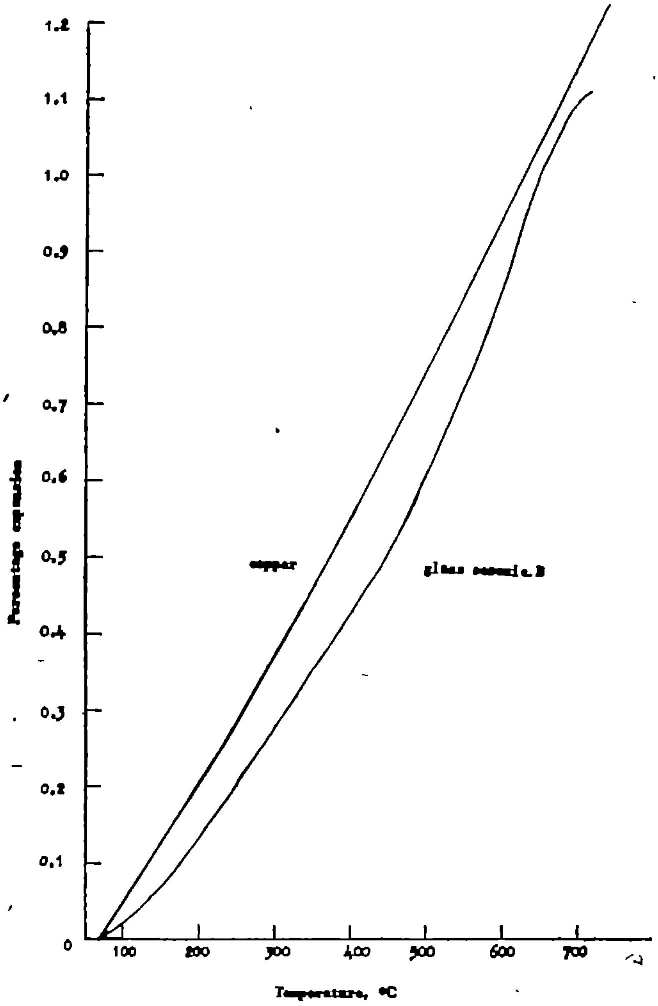

Fig. 5

Thermal expansion characteristics of copper and glass-ceramic B

5. Acknowledgment

The authors thank Dr. E. Eastwood, Group Director of Research, The English Electric Co., Ltd., for permission to publish this article.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Kerala Centre

Chairman's Address by Shri V. Ranganathan, M.I.E., at the Sixteenth Annual General Meeting of the Centre on March 9, 1963

After welcoming the invitees present in the meeting, Shri Ranganathan thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering the Chairman's Address, he said, 'Our meeting today is being held at a critical period in the history of the country. We are living in the shadow, if not in the limelight, of a national crisis. I shall not make any pious pronouncement on this emergency as appears to be the order of the day. The situation is far too grave for that, and at all times deeds are to be preferred to words.

In war and peace, our profession will give its best, but clearly the path of duty requires a renewed concentration and mobilization of our resources in the furtherance of the national effort. In the years to come, in the fulfilment of the cause of development of our country, let us play our part worthy of the trust and confidence of the nation.

For the last few years, we have been meeting and discussing in rather a leisurely manner, how to build up a free, prosperous, and democratic nation. But the situation has suddenly changed. A challenge has been thrown by a powerful neighbour threatening our progress and way of life, while we are striving hard to lift ourselves economically. There is hardly a task, in our efforts to meet this challenge, that does not deeply involve the engineer. Let us for a moment have a look at Kerala, our own State, and some of its problems and possibilities.

The economy of our State is a study in contrast. Endowed by nature with plentiful resources, Kerala has yet one of the most backward economies among all the States in the country. It accounts for nearly all the raw rubber produced in India. There are vast resources suitable for different kinds of industries. The heavy rainfall ensures abundant supply of water and the numerous rivers cascading down from the high ranges can offer enough power not only to our industries but also to the neighbouring States. Transport facilities are fairly adequate. The road density per square mile is high and is backed by an excellent network of inland waterways. Highly literate and efficient manpower, skilled and unskilled, is available in plenty.

Yet, with all these advantages, the State continues to remain industrially and economically backward. Smallest of the States in India, it has the highest density of population (1,127 per sq. mile as against the all-India figure of 373) and a low per capita income. The state has hardly any heavy industries worth referring to. Certain areas of the State have specialized in certain industries, *viz.*, cashew in Quilon, coir in Alleppey, wood and forest products in Kozhikode and Cannanore, and foundries in Palghat.

The performance of the agricultural sector is impressive, but there is hardly any scope for expansion in this direction as 53.6% of the population is dependant on agriculture. With 26% of the land area covered by forests and 7.3% barren and not cultivable, the per capita availability of land is only 27 cents.

It is therefore very clear that the future prosperity of the State lies in a balanced growth of large scale, small scale and cottage industries. An objective study of the first two allocations under the First and the Second Five Year Plans will show that Kerala has not been treated liberally. If the progress in the Central sector was little or nothing in the first two Plans, the progress of the State sector was equally unimpressive. Most of the major industries in the State had been started before the First Plan and continued to be more or less as they were all through the ten years of planning.

The State's Third Plan too has nothing ambitious to offer. Having regard to the stagnation of the previous decade, there is need for raising the tempo of development. It will be the duty of the State Government to launch a vigorous drive towards attracting investors, by making known the possibilities of starting a variety of agro-based, forest-based, and mineral-based, engineering and chemical industries in the State. The advantages that the State offer for location of industries should also be publicized widely.

Foremost among these is the possible availability of hydro-power in plenty at low cost. The terrain of Kerala offers facilities for generation of power at low cost. This natural advantage has not been exploited at a fast pace. Due to various factors, the harnessing of this source, estimated now to be in the region of three million kW at 60% load factor, has been very slow indeed, so that this year we are under serious power shortage. But properly planned and quickly executed, this State could well be in a position to sell power at a profit to the neighbouring States. This is a possibility that need be fully exploited by the State. With an installed plant capacity of 162 MW at the end of the Second Plan, hardly 5.5% of the State's potential has been utilized.

However, an ambitious programme of power development has been launched in the Third Plan aimed at more than trebling the installed capacity. The most heartening event in recent times is the grant of a loan of Rs. 25 crores by the United States of America to meet the entire cost of Sabarigiri (Pamba-Kakki) project, which would add 300 MW to the power capacity of the State. All going well, this project is expected to feed 100 MW into the State grid by the middle of 1965 when the first two of the six units will be commissioned.

The Idikki project has been sanctioned. This biggest single hydro-electric project of India, when completed, will have a generating capacity of 500 MW initially and 1,000 MW ultimately. Preliminary works have been started and the station may be commissioned late during the Fourth Plan or early in the Fifth Plan period.

While on the subject of hydro-electric projects, it will not be out of place for me to mention a few aspects of the concept and planning of such projects. So far we have been executing, what I may call copy-book schemes, each with a reservoir, tunnel, pipe lines and a power house. The pattern has been based on individual development. Now with the requirement of larger blocks of power, it is necessary to plan major power schemes, harnessing the combined waters of more than one basin in one stage. Modern techniques of tunnel driving can tackle even long tunnels, as much as 20 miles, and so transport of water from one valley to another is no formidable problem. Only the alignment is to be chosen such that there are suitable adits, or even when this is not possible, at least shafts of moderate depths are provided to give working facilities. Interconnection of adjacent basins can result in great economy. Integrated operation of stations must be visualized even in the planning stage. The capacities of the reservoirs and stations can be modelled, so that uneconomical storages are not created and standby generators are installed only to the minimum requirement. So far in this State, we have only small dams and comparatively small stations, whereas we could perhaps have had bigger ones. We need not be ashamed of our performance as this is only a feature of the early stages of development. I had seen much the same in some foreign countries where stations were situated in a similar manner and it was explained that this was the result of allowing individual companies to exploit the hydro-electric power resources.

Another point that I want to touch upon is that we should not shy away from the idea of diverting the waters of one river on to another. In many cases, this has resulted in the development of a large block of power. An instance in point is the Sabarigiri project where the first report was to develop the power by utilizing the waters of Pamba over a drop in the same river. I had the good fortune of drafting a report, where the waters of Pamba and Kakki were combined and taken on to the banks of Muzhiyar for producing a large quantum of power more economically. The Idikki project is another case where the waters of Periyar are thrown into Thodupuzha River. Of course, in all such diversions, the prior uses of water have to be considered, the riparian interests and the possible future uses have all to be given due provision.

I have so far been talking to you about the need for rapid development of our power potential to enable a quicker pace of industrialization. That is because, during the best part of my career, I have been associated with this facet of development.

Our country which has emerged from the years of inactivity has undertaken agricultural and industrial development programmes with attendant technical problems of great complexity. In the modern technological age, it is no longer the occurrence of natural resources that determines the prosperity of the country. It is by the development of resources, hard work, and technical advances and efficiency that we can hope to build our country's wealth and living standards. That has got to be achieved at a more accelerated pace than what we have been accustomed to all these years. In this effort, professional institutions like ours can play a large part. The learning and experience of an individual may help him in solving his problems, but they will be lost to the community unless he participates in organized discussions at a professional level. The main advantage accruing from a professional fraternity is that continuous advance of engineering knowledge and engineering talent of the country as a whole is facilitated.'

Rajasthan Centre

Chairman's Address by Shri K. C. Satsangi, M.I.E., at the Fourth Annual General Meeting of the Centre held on January 18, 1963

After welcoming the Chief Guest, Shri N. R. Mirdha, Minister for Agriculture, Rajasthan, and other invitees present in the meeting, Shri Satsangi thanked the Committee of the Centre for electing him Chairman for 1963.

Delivering the Chairman's Address, he said, 'This Institution provides a forum for engineers of all branches to discuss common problems to evolve suitable solutions and thereby endeavour to promote development of engineering knowledge. Being associated with the power department of the State, I like to-day to review the development of the power sector in Rajasthan.

In the present day world, consumption of electricity is one of the main indicators of economic prosperity of a country. The world has gone far ahead in electrical development and you would be interested to know where India stands in comparison with other countries. The per capita production of electricity in 1959, in some countries of the world, is given in Table 1.

Table 1

Per capita consumption in some countries

Country	Per capita electricity production in kWh
Norway	7,900
Canada	6,000
U.S.A.	4,500
Sweden	4,300
Switzerland	3,460
New Zealand	2,700
Australia	2,200
United Kingdom	2,000
Finland	1,750
Austria	1,730
Belgium	1,540
Union of South Africa	1,480
France	1,440
Netherlands	1,320
Japan	1,070
Denmark	880
Ireland	710
Spain	550
Chile	380

Table 1 (*contd.*)

Argentina	375
Mexico	295
Brazil	285
Turkey	90
India	36

It would be observed from Table 1 that India stands last. The position of Rajasthan *vis-a-vis* other States in India for the year 1959-60 is given in Table 2.

Table 2

Per capita consumption in Indian States

State	Units generated per kW of installed capacity per year	Per capita consumption
Mysore	4,680	37.92
Delhi	4,650	134.45
Bihar	4,460	16.87
Kerala	4,380	25.34
Madras	4,120	43.22
Punjab	4,040	23.72
Bombay	4,000	57.24
West Bengal	3,040	68.69
Jammu and Kashmir	3,000	14.09
Andhra Pradesh	2,800	14.38
Orissa	2,580	26.37
Uttar Pradesh	2,570	12.81
Madhya Pradesh	2,500	9.30
Rajasthan	2,430	4.07
Assam	1,400	2.15

Rajasthan's industrial development is much behind that of the other States (*vide* Table 2). Units generated per kW per year gives an indication of the load factor which increases with the increase of the base load of industries. Leaving Assam, Rajasthan is the lowest. Similarly, Rajasthan occupies the lowest position next to Assam regarding the overall per capita consumption of electricity.

There has been persistent demand both in the Legislature and the Press for extending electricity to rural areas, to provide amenities of life and source of power for working small and cottage industries and to stop migration of population to cities. The number of towns and villages electrified by 1960-61 and proposed to be electrified by 1965-66 in the various States in India is given in Table 3.

Table 3

Towns and villages electrified

State	Towns and villages electrified	
	1960-61	1965-66
Madras	10,151	18,000
Uttar Pradesh	4,928	9,928
Mysore	3,960	4,760
Punjab	3,000	4,600
Andhra Pradesh	2,800	3,725
Bihar	2,118	3,461
Kerala	1,600	2,600
Gujarat	681	1,700
Maharashtra	650	1,700
West Bengal	631	691
Madhya Pradesh	604	1,219
Rajasthan	131	434
Assam	56	116
Jammu and Kashmir	Not available	400

Here also, it will be seen that Rajasthan is the lowest leaving aside Assam.

The funds provided for rural electrification under the Third Five Year Plan to the various States are given in Table 4.

Table 4

Amount made available for rural electrification

State	Rs. lakhs
Madras	3,000
Uttar Pradesh	1,425
Andhra Pradesh	925
Madhya Pradesh	838
Maharashtra	740
Gujarat	700
Punjab	700
Mysore	425
Kerala	400
Bihar	300
Jammu and Kashmir	149
Orissa	140
Rajasthan	111
Assam	25

Here again, Rajasthan has the privilege of leading Assam only.

The comparative position of Rajasthan is not going to improve even after the Third Five Year Plan. It would be further observed that the per capita allotment of funds for power projects under Third Five Year Plan is the lowest for Rajasthan (*vide* Table 5).

Table 5

Per capita allotment in Third Plan

State	Per capita allotment in Third Five Year Plan, Rs.
Delhi	70.20
Punjab	34.07
Madras	30.90
Mysore	30.10
Jammu & Kashmir	27.37
Kerala	26.30
Orissa	25.90
Madhya Pradesh	23.90
Assam	23.80
Andhra Pradesh	18.40
Rajasthan	17.70

As is well known, Rajasthan was left far behind in the march for economic progress during the pre-independence era for various reasons, *viz*., historical, geographical, and political. Prior to the formation of Rajasthan as an integral unit, it consisted of many Princely States. As such, the scope for development on a reasonable and unified basis was not there, even though some of the bigger Princely States had made an attempt in this direction. Even after integration, much headway in all-round development of the State could not be made during the First Five Year Plan period, because Rajasthan was formed only in 1950, just on the eve of launching the First Five Year Plan. Naturally therefore, no planned schemes were then ready to be implemented. The Government of Rajasthan had to face the gigantic task of integrating the States and simultaneously prepare schemes for the First Five Year Plan.

As far as power development was concerned, a plan to rehabilitate old power houses and to augment their capacities, as also some extension to the distribution systems, was finalized by December 1954. Therefore, much headway could not be made except the preparation of designs, specifications, and placing of orders for equipment. In fact, the First Five Year Plan was practically adopted for implementation during the Second Five Year Plan period with certain additions. The Second Plan was thus a spillover of the First Plan practically in its entirety, in addition to (i) a share in the left bank generating station at Bhakra; and (ii) a share in the Chambal first stage covering Gandhisagar generating station in Madhya Pradesh with an allied transmission system in Rajasthan.

After completion of the schemes under the Second Five Year Plan, the position of Rajasthan was as given in Table 6.

Table 6

Position of Rajasthan in the Plans

Item	At the end of First Plan, kW	At the end of Second Plan, kW
Total installed capacity	34,900	1,08,992
Total firm capacity	15,399	64,830
Localities electrified	66	131

The proposal in Third Five Year Plan for the power sector in Rajasthan envisages two broad objectives. These are : (i) full utilization of hydel power resources, and (ii) development of thermal power (both steam and diesel) to meet the increasing requirements of those areas where hydel power resources do not exist or where this power cannot be transmitted from other regions. It is proposed to add 275 MW of generating capacity in the Third Plan. So far as hydel power is concerned, the objective implies the completion of Ranapratapsagar project and utilization of power (Rajasthan's share) to be generated from the left and the right bank power plants of the Bhakra project.

The Chambal system would feed Kota Division, Ajmer Division (except the districts of Jhunjhunu and Sikar), and the Districts of Bhilwara, Chittor and Udaipur in Udaipur Division. It is also proposed to feed Jodhpur *via* Pali from the Chambal system. Bhakra power will feed three districts of Bikaner Division and a number of towns in Nagaur, Jhunjhunu and Sikar Districts.

So far as thermal power is concerned, it is proposed to have a thermal station of about 100-120 MW. Rajasthan has joined Madhya Pradesh for installation of the units, each of 50-60 MW, in its thermal station at Satpura. In addition to these, a number of small Diesel sets with an aggregate capacity of about 10 MW would be installed. A turbo-set of 3 MW has also been planned to be installed at Jodhpur.

Even after achieving the above targets in full, the position of availability of power and the demand, on the basis of assessment made during 1959-60 by the Central Water and Power Commission would be as given in Table 7.

Table 7

Availability of power and load demand

Item	1965-66	1970-71	1975-76	1980-81
Load demand	281.00	524.00	875.00	1,345.00
Availability of power	99.00	318.16	325.16	325.16
Shortage	182.00	205.84	549.84	1,010.84

Note : (i) Figures for availability of power in 1965-66 are based on the present indications about the fulfilment of the targets ; and

(ii) Figures are in thousand kW.

Many new demands have come up which were not foreseen at the time of the load survey carried out by the Central Water and Power Commission and this factor is likely to further increase the shortfall by the end of Third Five Year Plan.

Due to certain changes in the design of the Ranapratapsagar project, its estimates have now increased from 1,292 to 1,832 lakhs of rupees. Due to shortage of funds and other procedural difficulties, power from Ranapratapsagar and Satpura projects is expected to be available in full only by the end of the first year of the Fourth Five Year Plan. This late receipt of power from these major projects would be responsible for increased shortfall during the Third Five Year Plan, particularly during the years 1964 and 1965.

To effectively utilize the additional power that would be made available from the Third Plan projects, a sum of Rs. 2,275.06 lakhs is needed for the transmission and distribution schemes. However, due to shortage of funds, only Rs. 948.50 lakhs are available. It would thus be apparent that, to fully utilize the power that would be made available, Rajasthan would need Rs. 1,032.17 lakhs more.

If Rajasthan is to find its proper place on the power map of India, during the Fourth Five Year Plan, generating capacity of nearly 600 MW would have to be added during this period. On the basis of forecast for power shortage made by the Central Water and Power Commission, it can be appreciated that achieving this object of meeting the shortage would mean skipping over of one plan. Though this would require herculian efforts in all directions, it is not impossible to achieve this. We should at least work with this objective in view.

Master plan

The first and foremost thing to be done is to prepare a master plan for power development up to 1980-81 at least. By having this master plan, we should be able to convince the Central Government, the Rajasthan Government, and the investing public, about our need and soundness of schemes to attract more funds. I feel, if such plan is ready, funds would be more easily available because the business community of Rajasthan who are investing crores of rupees outside Rajasthan could certainly be induced to invest necessary funds in the power development of Rajasthan, if they are assured of the soundness of the investment.

Dr. Bhaba, in his lecture recently delivered at the University of Rajasthan, indicated that the cost of generation of neuclear power at Ranapratapsagar will be 2.8 nP per unit as against the cost of generation of 3.7 nP per unit at power house busbars, indicated by the Madhya Pradesh Electricity Board in their revised project report of Satpura thermal station, which would work out as 3.95 nP per unit at Sawaimadhopur of Kota. The cost of generation of Bhakra power is 2.3 nP per unit and the cost of generation for Beas project is 2.06 nP per unit.

The only sources of power available to Rajasthan after the Third Five Year Plan are : (i) Mahi hydel project with a capacity of about 30 MW ; and (ii) Thermal plant at Palana with a capacity of about 50 to 100 MW (provided 40 lakh gallons of water per day is made available at Palana). It will thus be apparent that for future needs, Rajasthan will have to depend either on nuclear generation or the power generation will have to be shared from projects in the neighbouring States. For this, detailed studies are to be made to find out the most economical system of connecting Rajasthan grid with these sources of generation as also with the grids of the neighbouring States.

Rural electrification

Rural electrification also requires a detailed study because difficulties of extending electricity to rural areas have so far been: (i) limited requirements of power in these areas; (ii) low load factor; and (iii) large capital expenditure involved in laying out necessary supply mains. If therefore some means are found by which these unfavourable factors are removed to some extent, prospects of extensive rural electrification can be improved considerably. In Rajasthan, these unfavourable circumstances are more prominent because to cater small loads transmission lines have to be drawn for longer distances. We have, therefore, to give serious thought to develop a pattern of load, to enable us do the rural electrification economically. This is possible if we could find out load centres of about 3 to 5 MW scattered all over Rajasthan at a distance of about 50 to 60 miles, so that transmission lines could be drawn from main grid substations to connect these load centres, from where 11 kV lines could be drawn to cater the rural loads. There is a possibility of developing this pattern of load in Rajasthan because we have got mineral resources scattered in many parts of the State, the development of which could provide load centres. Similarly, industries like the textile mills, cement factories, etc., with a load of 2 to 5 MW could be suitably located for this purpose.

Preparation of master plan would also, not only avoid infructuous expenditure which may be incurred because of under-estimation in the selection of transmission voltages due to selection of schemes on the basis of piece-meal load surveys, but would also help in developing the pattern of load distribution throughout Rajasthan in such a manner as to cater for rural electrification in the most economical way.

If the physical targets of a particular Five Year Plan are to be achieved within the period of the same plan, it is very necessary that the plans should be made overlapping, *i.e.*, the Fourth Five Year Plan should be finalized latest by the end of third year of the Third Five Year Plan, so that the work of designing, preparation of specifications, placing of orders, planning of personnel programme, and giving necessary training wherever necessary, could be completed within the Third Five Year Plan itself and the actual execution could then be started from the first year of the Fourth Five Year Plan. It will thus be appreciated that the preparation of master plan is an absolute necessity and the money spent on this work would be a sound investment.

The main bottleneck coming in the way of achieving the physical targets of engineering projects in the various sectors is the procedural difficulties. The rules and regulations in force at present were framed at a time which was much different from the present one. At that time, the availability of man and materials was quite easy and the speed of the work was such that all the formalities of rules and regulations could be completed. The tempo of work has now considerably increased and so the old rules, regulations and schedule of power require radical changes to suit the present conditions. It would be of interest to know that the Planning Commission of the

Government of India are also now actively seized of this problem. Recommendations of the Plan Project Committee appointed recently by the Government of India, as published in the press, are given below.

Rules and regulations

Referring to the large number of checks through which the construction schemes have to pass, the report says that while certain checks were necessary in public undertakings, procedure must not be permitted to stifle the objectives. The rules and regulations governing these departments were framed when construction activity was of a limited order. With the launching of the development plans not only had the quantum of construction gone up but the variety of works had also increased. Qualitatively as well as quantitatively the task of the engineers has assumed vast proportions. The procedural codes on the other hand had remained more or less static ; in fact they had been made more rigid, resulting in increase of paper work.

The team felt that the system of administrative and financial control as being executed today was not conducive to the exercise of responsibility by senior engineers nor did it encourage initiative and progressive thinking in young engineers.

The team has recommended that there should be for each State one unified service of engineers for all branches of engineering in the State. The post of secretaries of the engineering departments should be held by the highest technical personnel, *e. g.*, the chief engineers of the States. This would lead to both economy in time and man power and improve efficiency in the execution of projects. The offices of the secretary and the chief engineer should be combined to avoid duplication of personnel and work.

Power of engineers

The report emphasizes that the powers of engineering officers were inadequate to cope with the increasing tempo of works. It has, therefore, recommended upward revision of powers of superintending engineers and executive engineers in the matter of technical sanctions, acceptance of tenders, sanction of extra items or substitution of items and grant of extension of time.

I am also happy to inform you that Shri Trilok Singh, I.C.S., and a member of the Planning Commission, has also suggested radical changes in the administrative set up. In addition to other things he has suggested that financial adviser and chief accounts officer dealing with projects should be under the control of the chief engineer. Sooner these recommendations are implemented the better it would be for the nation.

I have taken this opportunity to highlight all the points necessary for expediting the implementation of plan projects because after the declaration of emergency much emphasis has been laid on this from all quarters. The Rajasthan Government had previously taken a bold lead in introducing *Panchayat Raj* in the country and I cherish sincere hope that the same Government, which is headed by an engineer, would again give a lead to the country by taking bold decision of implementing these suggestions. If all these suggestions are implemented, our engineers would not be lacking in shouldering full responsibility for executing the projects economically and for timely achievement of physical targets.'

Summaries of Papers Published in the Journal Vol. 44, no. 4, pts. EL 2, and HI 1, December 1963

ELECTRICAL ENGINEERING DIVISION

Investigation of Line Current Harmonics with 3-Phase Bridge Rectifier Load

B. K. Bose

Associate Member

Polyphase industrial rectifiers are usually supplied by a short or medium length of transmission line. The line current wave shape of such rectifiers is far from sinusoidal and contains harmonics in the audio frequency range. From the view point of inductive coordination with neighbouring telephone lines, quantitative knowledge of such harmonics and their accurate distribution along the transmission line is important. In this article, the author has simulated a distributed parameter transmission line with the help of a model line and has experimentally investigated the quantitative distribution of line current harmonics with a 3-phase bridge rectifier load. The idea, it is concluded, can be projected to other types of rectifier installation and the conclusions drawn may be of use to telephone engineers.

Development of Single-Phase Induction Motor with partially Open Cage Rotor

Prof. M. V. Deshpande

Member

and

B. G. Desai

Non-member

The paper develops a new and unconventional method of starting a single-phase induction motor. The method consists in removing some of the rotor conductors of the cage winding. In the stator, a concentric sinusoidally distributed winding is used. The general principles of working of this type of motor are studied. Analysis of the running performance of the motor is done by the revolving field theory and the cross-field theory. A theory is developed relating the torque produced at start, the initial position of the open slots in the rotor at start, and the rotor copper loss. A 230 volts, 60 watts, 2-pole, single-phase induction motor was designed, built and tested using the principle of a partially open cage rotor. Curves showing the experimental results are given and compared with the calculated performance. Indian patent number 76926 was recently granted to the authors for the development of this new method. It is felt that this type of motor would make an important contribution for driving light duty loads of small capacities and the motor would effect considerable economy. Some research topics for further analysis are suggested. The limitations of the working of the motor at present are mentioned before it can be commonly used commercially.

Role of Nonlinearity on the Theory of Leakage Flux Demagnetization in Transformers

R. C. Pal
Associate Member

Investigation of peculiar experimental results on various transformers during their over-potential tests has led to the establishment of leakage flux demagnetization theory of transformers. The degree of leakage flux demagnetization depends upon the nonlinearity of the magnetization curves of transformers as well as the width of the copper-conductor used at right angles to the direction of flux. The theoretical results have been verified by experiments.

Analytical Treatment of Simultaneous Faults in a Power System Using α, β and 0 Components

Prof. H. N. Ramachandra Rao
Member

and

K. Parthasarathy
Non-member

In analyzing the performance of protective devices during simultaneous faults in a power system, it is necessary to calculate the system currents and voltages throughout the network. In this paper, the fault analysis is done analytically by using α, β and 0 components. The positive and negative sequence impedances of rotating polyphase machines can be assumed to be equal without serious error, thus making the use of α, β and 0 components practicable. The application of these components will prove to be very useful in obtaining simpler solutions for all cases of simultaneous faults, and hence, in studying the probable operation of protective relays. Only two cases of simultaneous faults are discussed in this paper, and the other cases may be worked out on the same lines.

Economics of Long Distance Extra High Voltage Transmission Lines

S. M. Zubair
Member

and

F. C. Kohli
Associate Member

Demand for electricity in this country is growing at such an accelerated rate that during the decade 1966-76, generating capacity additions of 2,000 to 3,000 MW per annum may be necessary. A considerable part of these capacity additions will be thermal plants using conventional fuels. It will be more economical to plan power plants having capacities ranging from 500 to 1,000 MW with large size units of 150 MW and

above costing less per kW and yielding higher thermal efficiency than smaller units spread over a large number of power plants. Such large capacity plants operating at 70-80% load factor will each require 1.5 to 3 million tonnes of coal per annum. Considering that the coal haulage distances to the load centres would in many cases be over 400 miles and that coal earmarked for power generation would be of low heat value and high ash content, a study is made in this paper to determine the comparative economics of locating large capacity plants in coal bearing regions and transmitting electrical energy to the load centres over extra high voltage transmission systems, as against locating power plants near the load centres and hauling the coal over the railways. A study is first made of the capability limit of extra high voltage transmission systems considering the effect of intermediate switching stations, series capacitor compensation and bundling of conductors. Transmission cost studies are made for varying power blocks to be transmitted to various transmission distances. General conclusions resulting from the studies are given. Evaluation of electrical transmission costs *vis-a-vis* railway transport costs on a long term basis taking into consideration the load growth expected indicates that a 400 kV transmission system with an initial load of even 300 MW is more economical than railway transport if the initial load is expected to double itself within the next five years. Effects of variation of equipment costs and the load factor are indicated.

HINDI SECTION

Building Materials and Building Techniques in India

G. C. Mathur

Non-member

The problems confronting the building industry are discussed. The means to achieve greater speed, better quality of construction and economy in building costs are pointed out while discussing the developments in building materials and construction techniques. The importance of traditional and conventional materials and the ways to increase their production are discussed. The scope for new building materials and utilization of industrial wastes for this purpose are indicated. The traditional and current techniques of building construction, and new techniques for roofing and walling are described. In effecting reduction in building cost, the role of functional design is explained. Techniques of low cost housing are also dealt with. A discussion with reference to provision of services, application of research, dissemination of technical information, and international cooperation in the solution of building problems is included.

Concrete Sleepers

M. Srinivasan

Member

Railways in many countries are now using concrete sleepers due to scarcity of timber. Long welded rails last longer on heavy sleepers and the maintenance cost is low. A study on railway sleepers is presented in this paper including a special reference to the use of concrete sleepers on the French, British, Swedish, Belgian, Italian and Dutch Railways. Their advantages and disadvantages under varying conditions are also discussed.

Curing of Concrete

Curing of concrete is a very important operation in the utilization of concrete. Various methods of curing concrete, and their special advantages and limitations are discussed.

Mechanism of Cavitation and Cavitation Damage

C. B. Mishra

Non-member

The mechanism of cavitation and cavitation damage are analyzed in this paper. A short literature survey of this field is made. Experimental techniques and theoretical studies of transient and steady state cavities are discussed. The effects of turbulent pressure fluctuation and boundary layer and the importance of nuclei in the inception of cavitation are examined. It is concluded that the present knowledge in this field is insufficient and extensive research work is necessary.

Asbestos

This paper describes the chemical composition of asbestos and its sources, and the various uses for which it is utilized in engineering works.

Sir Ganga Ram—a Great Indian Engineer

Vishwambhar Prasad

Associate Member

Sir Ganga Ram was born in April 1851 in a middle class Hindu family in Punjab. After qualifying from the Thomason College of Civil Engineering, Roorkee, in 1873, he was employed as an assistant engineer in the Buildings and Roads Branch, Punjab P.W.D. He soon distinguished himself as an efficient engineer and was sent to England for specialized training in public health engineering. After a successful professional career, he retired prematurely in 1903 from the Punjab Government Service, and joined the then Patiala State Government as Chief Engineer. After retiring from Patiala in 1911, he was engaged in agricultural farming, and was a pioneer in using methods of lift irrigation by steam, oil and electricity and successfully transformed large tracts of barren land into fertile fields. He earned in millions and gave away large sums of money in charity, specially for the cause of widows and the sick. He was selected as a Member of the Royal Commission on Agriculture appointed by the Government of India under the Chairmanship of Lord Linlithgow in 1925. When he accompanied the Commission to England, he passed away on July 10, 1927, at the age of 76, in London and was cremated there.

INSTITUTION NOTICES

Sections A and B of the Associate Membership Examination— Option to students to appear in the old scheme

It is once again notified for the information of candidates that they will not be permitted to appear for the **Old Scheme** of examinations to be held in May 1964, in Sections A or B, unless they have at least one exemption to their credit. Candidates not fulfilling the above condition and submitting application forms for the **Old Scheme** of examinations will have their applications rejected.

Application forms for Sections A and B of the Associate Membership Examination (Old Scheme) to be held in May 1964

Application forms for Sections A and B of the Associate Membership Examination (old scheme) to be held in May 1964 are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions are also attached with the application forms, and they may be detached for reference, if so desired. All these forms, the programme of examinations and the detailed instructions are printed on **white paper** to distinguish them from those applicable to the new scheme which are printed on **pink paper**. Students are notified that no further application forms will be distributed to them.

Applications complete in all respects and accompanied by examination fees for admission to the May 1964 examinations and two copies of passport size photograph pasted in the spaces provided on the application form should reach the Head Office before 4.00 p.m. on **Monday, March 16, 1964.**

Application forms for Sections A and B of the Associate Membership Examination (New Scheme) to be held in May 1964

Application forms for Sections A and B of the Associate Membership Examination (new scheme) to be held in May 1964 (**printed on pink paper**) are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions (**printed on pink paper**) are also attached with the application forms and they may be detached for reference, if so desired. Students are notified that no further application forms will be distributed to them.

Applications complete in all respects and accompanied by examination fees for admission to the May 1964 examinations (new scheme) and two copies of passport size photograph pasted in the spaces provided on the application form, should reach the Head Office before 4.00 p.m. on **Monday, March 16, 1964.**

Sections A and B of Associate Membership Examinations— Limitation to number of candidates at examination centres

The Examinations Committee have decided that with effect from the May 1964 examinations, the number of candidates appearing at any examination centre should be restricted to 750 only, in view of the difficulties experienced in making arrangements.

Candidates intending to appear in the examinations should mention in the examination application form the names of three examination centres in order of preference, and the Controller of Examinations will allot to each candidate the centre at which he will be permitted to appear. Candidates who fail to mention more than one examination centre will be allotted any centre of examination at the discretion of the Controller of Examinations. No individual representations will be received after the allotment of the examination centre is made.

New examination centres at Durgapur, Hubli, Mysore and Port Blair (Andaman Islands) will be available for the May 1964 examinations.

Special Short Course on Steel Structures, Indian Institute of Technology, Kharagpur, April 15-25, 1964

A short refresher course on 'Design of Steel Structures' will be held in the Civil Engineering Department of the Indian Institute of Technology, Kharagpur, from April 15-25, 1964. The course is designed to provide the essential background to a rapidly growing subject ; and keep the participants abreast of the developments in the field of structural steel design with particular reference to the development of the codes of practice and ultimate load considerations. Details can be had from the Director, Indian Institute of Technology, Kharagpur.

International Competition for the Project of a New Excelsior Thermal Establishment in Montecatini Terme, Italy

The Montecatini Terme Company announces an international competition for the project of a thermal establishment to be constructed in Montecatini Terme on company-owned property situated in the thermal park.

The project must comply with the requisites of a thermal establishment for balneotherapy, hydropinoc, inhalatory and gynecologic treatments. The new building must join functionally with the drinking hall and entrance lobby of the existing small Excelsior baths which will not be demolished. Hence the following requisites : entrance lobby, general assembly halls, and general accommodation on the ground floor, with the treatment departments located on the upper floors. Below ground level will be located the general technical installations, the service department, and no less than one hundred toilets for clientele use. This number includes those already existing which will be fully re-modernized.

The treatment departments will be thus composed of : (i) 48 small rooms for diversified treatments ; (ii) 2 rooms for collective dry inhalations ; (iii) 6 compartments for individual dry inhalations ; (iv) 24 compartments for humid inhalations, (v) 12 compartments for aerosal, (vi) 2 compartments for tubotympanal insufflations, (vii) 4 compartments for alternating inhalations, and (viii) relative clearing rooms, waiting rooms, and space for department services and medical examination, etc.

The Montecatini Terme Co. will furnish the contestants with the following materials :

(a) A plan of the constructable area in the ratio of 1 : 200, showing in pink the outline of the drinking hall and the entrance lobby of the present Excelsior establishment that are to be preserved and included in the present project, and showing in yellow the part that will be demolished to make room for construction ;

(b) A general plan of the Montecatini thermal spa in a 1: 100 ratio ;

(c) Several photos of the Excelsior drinking hall and entrance lobby that are to be preserved ;

(d) A plan on a 1: 100 scale of the basement now existing below the two halls ; and

(e) A prospect of the drinking hall.

Each application, accompanied by a 10,000 liras as entrance fee, must be addressed to the Montecatini Terme Co. Viale Diaz 2/A, Montecatini Terme (Pistoia), Italy.

INSTITUTION NEWS

Proceedings of the Fourth Congress of Federation Internationale de la Precontrainte, May-June, 1962

The Fourth Congress of the Federation Internationale de la Precontrainte took place in Rome and Naples from May 29 to June 2, 1962. Seventy-eight papers from twenty countries were presented on four main themes : (i) Results of research with special reference to durability and fatigue; (ii) Site considerations (problems and difficulties) : remedies and solutions; (iii) Economics of prestressed concrete in relation to regulations safety, partial prestressing, lightweight concrete, etc., and (iv) Progress in precast factory manufacture and standardization.

The proceedings of these technical sessions are being published in two volumes. Volume 1 will contain all the papers. Each paper is in one of the Congress languages (English, French, German, Italian, Russian and Spanish) but has summaries in all six languages, and the discussions which took place at the technical sessions, each contribution being printed in the language in which it was delivered.

Volume 1 is now available and will be despatched as orders are received and recorded. Volume 2 will be sent when it becomes available. The price of the two volumes will be £12. It should be noted that the two volumes cannot be ordered separately.

The technical sessions in Rome were followed by a one-day Symposium on 'Prestressed Concrete Roads and Airfield Runways in Naples', organized by the F.I.P. in conjunction with the Permanent International Association of Road Congresses. The *Proceedings* of this symposium are being published in a separate volume. This consists of eight papers (three in English, three in French, and two in German), with introductions and contributions to discussions, printed in the languages in which they were given. The price of this volume is £2.

Order forms are available from the Federation Internationale de la Precontrainte, Terminal House, Grosvenor Gardens, London, S.W.1. and the completed form and the remittance should also be sent to them.

Publications of the Institution of Electrical Engineers, London

The *Journal of the Institution of Electrical Engineers* will have a new title next year, *viz., Electronics and Power*. The previous title will be retained as a sub-title. The first copy of this publication will appear in January 1964. It will be published monthly and its cost to non-members will be 10s. a copy or £5 a year.

Changes in the Quarterlies

The three 'Quarterlies' published by the Institution of Electrical Engineers will also be renamed as *Electronics Record*, *Power Record*, and *Science and General Record*. The 'Quarterlies' will contain the papers from the *Proceedings* that fall within the scope of the corresponding Divisions of the Institution. However, the new periodical, *Electronics Record*, will appear at two-monthly intervals beginning February 1964. The prices of these periodicals to non-members will be as below :

		Single copy	Annual subscription
Electronics Record	..	£1	£5.52
Power Record	..	£1	£310s.
Science and General Record	..	15s.	£210s.

Members of the Institution of Engineers (India) are eligible for a concession of 25% on these rates.

FORTHCOMING CONFERENCES

Fifth Shipping and Shipbuilding Conference, Calcutta, February 10-14, 1964

The Fifth Shipping and Shipbuilding Conference will be held in Calcutta between February 10-14, 1964. Foreign delegates, representing shipping and shipbuilding interests, are expected to attend. The conference will provide a forum for an exchange of ideas on the design, construction, operation and maintenance of ships, and problems relating to shipping and shipbuilding in India and other parts of the world. A number of technical papers have been received from individuals and organizations in India and abroad.

Symposium on 'Testing and Evaluation of Materials'
Calcutta, February 1964

To commemorate the Golden Jubilee of the Government Test House, Alipore, Calcutta, the Government of India will hold a symposium on 'Testing and Evaluation of Materials' during the later part of February 1964. The Government Test House, since its inception, has been engaged in the evaluation of materials and processes, research on industrial problems and methods of testing, and assistance to the Indian industry in the various fields of science and engineering.

The scope of the symposium is broadly given as :

1. Importance of testing and evaluation of materials in the context of economic development of the country;
2. Statistical and mathematical approach to testing ;
3. Non-destructive testing of materials ;
4. Testing and standardization of electrical engineering materials and appliances ;

5. Recent advances in the testing and evaluation of boilers and pressure vessels;
6. Testing and evaluation of metals—including finished engineering materials ;
7. Chemical products consisting of petroleum products and lubricants, ores and minerals, ceramics, paper and paper products, rubber and plastics, and paints and pigments ;
8. Modern physico-chemical methods of testing and analysis;
9. Materials for building and road construction and sanitary fittings ;
10. Textile and allied materials; and
11. Precision engineering measurements

Contributions in the form of papers and reviews on subjects conforming with the main idea and scope of the symposium are invited. Further details can be had from the Director, Government Test House, 11/1 Judge's Court Road, Alipore, Calcutta 27.

39th Annual Meeting of the Association of Asphalt Paving Technologists, Dallas, Texas, February 17-19, 1964

The 39th Annual Meeting of the Association of Asphalt Paving Technologists will be held in Dallas, Texas, from February 17-19, 1964. The Association of Asphalt Paving Technologists, with membership on a worldwide basis, has as its aims the advancement of asphalt paving technology through encouragement of research and communication between its members. A feature of one of the five technical sessions will be a symposium on 'Thickness Variation of Asphaltic Concrete,' at which the implications of new electronic pave controls will be discussed with respect to riding quality, performance, design and material quantities. At the remaining four technical sessions, nineteen papers will be presented for discussion. The topics covered will include mix design, asphalt tests and performance, slurry seals, AASHO road test, dynamic testing, compaction, black base design, structural design and rheological properties of asphalt. Further programme details and paper abstracts may be obtained from Ward K. Parr, Secretary-Treasurer, 1224 East Engineering Building, P.O. Box 619, Ann Arbor, Michigan, U.S.A.

The Third Festival of Technical-Scientific Films, Budapest, April 15-22, 1964

In Budapest, two Technical-Scientific Film festivals had taken place in 1959 and in 1961 with the participation of 25 countries, presenting altogether 270 films to a number of foreign and home specialists. Based on the success of the two preceding festivals, the Federation of Technical and Scientific Societies has decided to organize for the promotion of technical sciences as well as to further the cause of technical-scientific films and to enable the exchange of international experiences in the latter field, a colloquy on 'The Technical and Natural Scientific Film in the University and Higher Education' and a show on 'Means of Technical-Scientific Cinematography and Photography'.

Further details can be obtained from Filmklub-Fesztival Iroda, V Szabadsag-Ter 17, Budapest, Hungary.

International Conference on Magnetic Recording, London, July 1964

An International Conference on Magnetic will be held during the week beginning July 6, 1964, at the Institution of Electrical Engineers, London. The conference is sponsored by the British Institution of Radio Engineers, the Institute of Electrical and Electronics Engineers and the Institution of Electrical Engineers. The scope of the conference will cover all magnetic recording on moving media and will include sessions on audio, video, computers and data recording. The written material for the conference will consist of papers of a length not greater than 2,000 words, or equivalent including illustrations. Prospective authors should submit full texts (three copies) by March 31, 1964.

Further details concerning the conference can be obtained from the International Conference on Magnetic Recording Secretariat, c/o The Institution of Electrical Engineers, Savoy Place, London W.C. 2, to which address synopses of papers and manuscripts should also be sent.

BOOK ACKNOWLEDGMENTS

1. **Strength of Materials.** D. R. Malhotra. *M. G. Technical Publications*, Hoshiarpur, Rs. 10. 392 pages.

This book is written for the use of diploma students in professional courses. Some chapters like 'Bending moments', 'Torsion', 'Framed structures', and 'Deflection', have received special treatment in order to give the student a better grasp of the subject. A chapter or testing and testing machines has been included.

2. **Strength of Materials.** B. N. Thadani. *A. R. Sheth & Co.*, Bombay, Rs. 10. 454 pages.

This book is intended for the use of students of degree courses in engineering of Indian universities and for those studying diploma courses. The fundamental concepts of strength of materials have been explained. Metric system has been adopted throughout the book in view of the changeover to metric units. Some of the worked out problems and the typical problems with answers that are included in the book enhance its utility.

3. **Metric Guide for Civil Engineers and Architects.** J. K. Varshneya. *Sri Mandir Karyalaya*, Delhi, Rs. 5.50. 126 pages.

This book is a collection of papers written by the author on various aspects of the metric system as applied to the building industry, which were published in various technical journals of India. Useful data in the metric system in the field of building and architectural engineering are presented in the book. A paper entitled 'Modular Coordination in Building Industry' is included in the book to emphasize the substantial economies that can be achieved by the use of the technique of dimensional coordination. This book will be of help to building engineers, students, architects and builders in changing over to the metric system.

4. **An Introduction to Water Supply.** D. R. Bhise. *The All-India Institute of Local Self-Government*, Bombay. 121 pages.

This is intended to serve as a text-book for the use of students preparing for diploma examinations and specialized professional courses. The basic fundamentals of the subject of water supply are explained in the book. The practical aspects of the subject are discussed for the guidance of junior engineers and plant operators.

5. **Professional and Trade Organizations in India.** Edited by Ing. H. Kothari. *Kothari Publications*, Calcutta, Rs. 5. 151 pages.

This compilation lists India's professional and trade organizations. Included in this reference work are also foreign professional and trade organizations. The publication will be of use to libraries.

6. **Concrete : Plain, Reinforced, Prestressed Shell.** R. H. Evans and C. B. Wilby. *Edward Arnold (Publishers), Ltd.*, 45s. 252 pages.

This book deals with the basic theory for the design of structural elements of reinforced and prestressed concrete and is meant for the use of students and structural engineers and architects. The analysis of shells in a form suitable for design purposes has also been given. The American as well as the British Codes of Practice are often quoted. As an additional aid to the student, a number of examination questions are included in the book.

7. **Applied Mechanics.** J. Hannah and M. J. Hiller. *Sir Isaac Pitman and Sons, Ltd.*, 18s. 398 pages.

This book is designed to cover the needs of students preparing for examinations of professional engineering institutions, and those studying for diploma and degree courses in engineering. The theory is developed in such a way as to keep the number of formulæ to be memorized to the minimum. The principles of forces have been explained with diagrams. The major topics include worked out examples and specially chosen typical problems to be attempted. Detailed treatment has been given to the nature of experimental error, graphical work, the practical aspects of friction, and properties of materials and fluids. The concept of intertia force is used consistently throughout the text in solving dynamics problems.

8. **Microwave Tubes and Semiconductor Devices.** G. D. Sims and I. M. Stephenson. *Blackie and Son Ltd.*, London, 75s. 388 pages.

The book essentially is a survey of the principles of operation of microwave valves and their uses, and is meant for the practising microwave engineers, valve designers and advanced students of physics and electrical engineering. Energy conversion and the properties of space charge waves have been dealt in the opening chapter. In the subsequent chapters, the principles of various microwave tubes and klystrons have been clearly explained. The formation and focussing of electron beam has been treated thoroughly. Stress is laid on the chapters dealing with modern low-noise devices such as parametric amplifiers, cyclotron wave tubes and masers.

9. **Steam Tables in Metric Units.** S. A. Urry. *Sir Isaac Pitman and Sons, Ltd.*, 2s. 17 pages.

This publication presents pressure and temperature tables for saturated water and steam extending to a temperature of 1000°C. and 1,000 kg force per cm.^{2} pressure and are based on the values obtained by Vukalovitch using the association theory of real gases. Tables 1 and 2 refer to saturation conditions, Table 3 to 6 are for superheated steam and compressed water, and the volumes given above zigzag lines in Tables 3 to 6 apply to water. Intermediate values of enthalpy, internal energy and entropy may be obtained with reasonable accuracy by linear interpolation of pressure and temperature. The tables will be useful to the student as well as the design engineer.

PUBLICATIONS RECEIVED

A copy of the booklet entitled 'Steel : an Expanding Industry' has been received from the Publicity Department of the Dunlop Rubber Co. (India) Ltd., Calcutta. This booklet deals with the importance of steel in the economic development of the country, availability of raw materials, growth of the steel industry in the last decade and the future outlook of the industry. It also contains illustrations of the major steel plants in the country and some important statistics.

A copy of a publication entitled 'Personal Management in Japan, U.S.A. and Britain' has been received from the Director (Technical Assistance), National Productivity Council, New Delhi. This publication contains the report of the Indian Productivity Team which visited the above countries. This publication covers the method of recruitment of personnel, placement and training, wages, allowances and welfare ; and industrial and relations in those countries.

A copy of a publication entitled 'Quality Control in Japan, U.S.A. and Britain' has been received from the Director (Technical Assistance), National Productivity Council, New Delhi. This publication covers the report of the Indian productivity team which visited the above countries and a summary of important recommendations.

The inaugural number of the quarterly technical journal entitled *Construction*, a journal published by the Hindustan Steel Ltd., has been received from the Chief Engineer's Office, Rourkela Steel Plant, Rourkela. The first issue mainly contains papers reviewing the progress of the public sector steel plants and a paper entitled 'Engineering Today' by Dr. A. N. Khosla.

A copy of the *Indian Journal of Power and River Valley Development* special number entitled 'Hydraulic Structural Special Number, 1963' has been received. This special number is published in three sections, *viz*., (i) Analysis and design of dams, (ii) Analysis and design of power house and appurtenants, (iii) Other topics connected with hydraulic structures. The publication contains 46 papers which cover the above topics.

A copy of the 104th Anniversary Number of *The Indian and Eastern Engineer* has been received. It contains 49 articles covering the field of engineering sciences. The topics range from civil, mechanical, chemical, transport and aerospace engineering to electrotechnology, mining and metallurgy, nuclear and materials technology, computation technology, history of technology and bio-engineering and agricultural engineering. The editorial entitled 'Reflections and Repercussions' analyses the problems facing the country and the necessity for reorienting its policies, plans and concepts to suit the new techno-industrial and socio-scientific structure,

LETTER TO THE EDITOR

Sir,

Unscrupulous publishers concerning members of the Institution

In January this year, I received some printed literature regarding the publication of a comprehensive book covering 'Scienific and Technical Personnel in India', sent by a firm of publishers named 'Tradesmen & Men India, 1369 Kashmere Gate, P.O. Box 1456, Delhi'. They probably got my name from the list of Corporate Members published by our Institution. They expressed their professed intention of publishing names of all qualified engineers, technicians and scientists in India in a single book and requested me to send Rs. 10 for inclusion of my photo print. Considering this to be an acceptable idea, I had sent full personal particulars along with a postal order of Rs. 10.

After waiting in vain for two months, I sent reminders without receiving any information from them up to this date. I am constrained to think that the money is lost and I am afraid that several other engineers must have had the same experience.

Recently I have received almost identical papers from another publisher named Premier Publishers (India), 2695A Deshbandhu Gupta Road, Karol Bagh, New Delhi 5, seeking to publish a similar book but entitled 'Men of Science & Technology in India'.

I am really skeptical about this affair and I thought it my duty as an engineer to report this to you just in case other engineers might not have to share the same experience as mine.

D. N. Sinha
Associate Member
c/o Air Conditioning Corporation Ltd.,
2 Justice Chandra Madhab Road, Calcutta 20.

LIST OF NEW ELECTIONS AND TRANSFERS

(*Continued from Bulletin for June 1963*)

GRADUATES

No.	Name	No.	Name
1692	Raman, P. S.	1701	Aggarwal, Narendra Kumar†
1693	Ramanathan, Venkateswaran	1702	Pall, Avtar Singh†
1694	Ashwatha Narayana, A.	1703	Pran Nath†
1695	Singla, Purushottam Lal	1704	Singla, Vishwa Nath†
1696	Santhanakrishnan, S.†	1705	Sharma, Bhanu Pratap†
1697	Sreenivasan, Nuggehalli Gujje-Gowda†	1706	Swaminathan, Tazhada Madhathil†
1698	Muthukrishnan, R.†	1707	Srinivasan, Tiruchirapalli Subramanyam†
1699	Toor, Gurcharan Singh†	1708	Rastogi, Reoti Raman
1700	Joshi, D. R.†	1709	Balachandran, Muthuswamy

† Transferred from Student.

GRADUATES (*contd.*)

No.	Name
1710	Sreenivas Rao, Poojari†
1712	Mohan Rao, Chodavarapu Murali†
1713	Khatri, Muhammad Siddiq
1714	Natarajan, Subramaniam†
1715	Bhardwaj, Niranjan Lal†
1716	Kotak, Tulsidas Lokumal†
1717	Bagga, Inder Singh
1718	Joseph, Thattungal Joseph
1719	Kumar, Krishan Lall
1720	Dembla, Ghansham Tolaram
1721	Purohit, Anant Shankarrao
1722	Ghate, Ashok Dinakar
1723	Chaobal, Nandkishor Madhukar
1724	Bhanap, Govind Madhav
1725	Sukthankar, Subhash Kashinath
1726	Pattanaik, Akshyabandhu
1727	Surendar, Chintala
1728	Varughese, Chandy Kallookkattu
1729	Desai, Praful Ratanlal
1730	Khakar, Nalinikant Shyambhai
1731	Khandekar, Anand Ramchandra
1732	Mehta, Piyushkumar Prabhudas
1733	Das, Samir Kumar†
1734	Sastry, Kavita Sambat†
1735	Karekar, Shashikumar Narhar†
1736	Sampath, Bindiganavile†
1737	Gopalan, Chathangoth†
1738	Khanna, Ravinder Nath†
1739	Taneja, Balraj†
1740	Lt. Hukum Chand†
1741	Vaidya, Vinayak Raghunath†
1742	Krishnamurthy, Lalgudi Sambaparameswara†
1743	Krishna Rao, Tammana†
1744	Sharma, Mahesh Chandra†
1745	Chandrasekaran, Tanjore Panchapakesan†
1746	Bhandari, 2/Lt. Madan Lal†
1747	Madan, Cpl. Daljit Singh†
1748	Banerjee, Cpl. Sakti Pada†
1749	Dhanaseelan, Cpl. Joseph Richard†
1750	Rastogi, Krishna Kumar†
1751	Gulati, Bhim Sain†
1752	Arjan Singh†
1753	Suri, Kulbhushan Kumar†
1754	Agrawal, Krishna Swarup†
1755	Bhatia, Kuldipak Raj†
1756	Kotwala, Chandrakant Jagjivandas†
1758	Pandarinath, Batni Ranganatharao†
1759	Dubash, Dara Jehanbux†
1760	Sanap, Vilas Kashinath†
1761	Wagh, Ravindra Dattatraya†
1762	Mehta, Devi Dayal†
1763	Sharma, Jagdish Prasad†
1764	Mehta, Chandrakishor Prabhashanker
1765	Bhartiya, Atam Prakash†
1766	Mathur, Satish Chandra
1767	Treasurer, Ashvin Vinaykant
1768	Sehgal, Krishan Gopal†
1769	Monohar Singh
1770	Gangopadhyay, Sunil†
1771	Gautam, Lakshmi Narayan†
1772	Garg, Ishwar Chandra
1773	Kalsi, Rajender Kumar†
1774	Arora, Radhe Shyam†
1775	Nigam, Maheshchandra Shankerlal†
1776	Verma, Darshan Lal
1777	Kotkar, Eknath Ziparu
1778	Ganesh, Sub.-Lt. Anantanarayanan
1779	Mukherjee, Shankar Prasad
1780	Narayan, Narasimhan
1781	Siodia, Dara Pirojshaw
1782	Singh, Manmohan†
1783	Khanna, Om Prakash
1784	Majumder, Balendranath†
1785	Srinivasan, M. D.
1786	Basu, Dipendra Kumar†
1787	Sur, Jaydeb†
1788	Bandopadhyay, Shyamal Kumar†
1789	Palit, Aditya Nath
1790	Sen, Dipak Kumar†
1791	Nag, Kamalesh Chandra†
1792	Khan, Ram Mohan
1793	Rajgarhia, Nawal Kishore
1794	Kasturi, Parthasarathi
1795	Roy, Bijon Behari
1796	Mandal, Manmatha Nath†

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† Transferred from Student.

GRADUATES (*contd.*)

No.	Name
1797	Pujari, Nirmal Chandra
1798	Banerjee, Sunil Kumar†
1799	Malaviya, Gopal Krishna
1800	Majmudar, Rohit Sumantray
1801	Ramachandran, Sirugamani Swaminathan
1802	Taneja, Yog Raj†
1803	Ghosh, Bimal Chandra†
1804	Banerjee, Amiya Ranjan†
1805	Pakkiriswamy, Swamy†
1806	Ramaswami, Vallinayagamudar†
1807	Khambatta, Sarosh Minocher†
1808	Ramalingham, Kumaraswamymudaliar
1809	Jagannathan, A. Padmanabhan†
1810	Subramanian, Malli Ramaiyer
1811	Ramanathan, Ramakrishnan†
1812	Vasudevan, Rathnasabapathy†
1813	Narasimha Rao, Krovvidi Venkata†
1814	Sankaran, Chikkalnarasayya Subramania
1815	Seshagiri Rao, Challakere Srinivasarao†
1816	Mehta, Virender Narain†
1817	Seshadri, Soundararajan†
1818	Padmanabhan, Kattuputur Lakshmanan
1819	Swaminathan, Subramania
1820	Prabhakar, Baldev Raj†
1821	Saran, Satya Pal†
1822	Venkataraman, Komaratchi Subramanya†
1823	Chatterjee, Krishna Prasad†
1824	Yohannan, P.M.†
1825	Sidhu, Santa Singh†
1826	Samant, Govind Mahadeorao
1827	Gopal Rao, Kandikonda Surya†
1828	Soneji, Kanayo Tolaram
1829	Sarma, Vadapalli Kameswara†
1830	Reddy, Gukal Sreeramulu†
1831	Seetharaman, Theagaraj†
1832	Manchanda, Harish Chander†
1833	Mehta, Kishorchandra Gokaldas†
1834	Bhagwat, Balkrishna Anant†
1835	Shah, Jayantilal Jamnadas
1836	Venkateshwar Rao, Dama
1837	Sen Gupta, Sujit Kumar
1838	Narang, Sunder Shain†
1839	Hanumantha Rao, Korukonda
1840	Pathak, Shridhar†
1841	Upadhyaya, Pukh Raj†
1842	Satyanarayana Raju, Kapalli†
1843	Padmanabha Iyer, Narayanaiyer
1844	Virdi, Karnail Singh†
1845	Balarami Reddy, Konda
1846	Narayanan, Kandasamypillai†
1847	Ghosh, Sunil Kumar†
1848	Pramanik, Nikhilendu†
1849	Pahwa, Surinder Raj
1850	Saxena, Mahendra Behari Lal
1851	Rangarajan, Mayavaram Aravamudhan†
1852	Malhotra, Madan Mohan
1853	Pande, Pramod Kumar
1854	Srinivasan, Venkateswaran
1855	Chandrasekaran, A. G.
1856	Srinivasan, Balasundaram
1857	Chatterji, Arun Kumar
1858	Balagangadhar, Obulampalli
1859	Mallapurkar, Shreekant Manjunatha
1860	Goel, Kul Bhushan
1861	Ghosh, Debdas
1862	Pandian, Srinivasan Chendur
1863	Rajaraman, Rengasamy
1864	Raghu, Rayadurgam Venkobachar
1865	Santhanam Krishnan, Vayalanellore Sundaram†
1866	Krishnaswamy, Mahadevaiyer†
1867	Jeyasingh, Monickam Guruveera
1868	Nath, Kalyan Kumar
1869	Datta, Krishna Gopal
1870	Roy, Sumit
1871	Gupta, Virinder Parkash
1872	Subramanian, Sundaresan
1873	Mitra, Arun Kumar†
1874	Nischal, Rajinder Kumar†
1875	Ghosal, Arun Bijay
1876	Khurana, Mohan Lal†
1877	Om Prakash†
1878	Mittal, Man Mohan†
1879	Das, Sub.-Lt. Sreejit Ranjan
1880	Nathani, Gobindram†
1881	Mohan Lal, Sgt. Madan†

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† Transferred from Student.

GRADUATES (*contd.*)

No.	Name
1882	Gupta, Harish Chander†
1883	Verma, Gur Pal
1884	Pyara Singh†
1885	Yardi, Jawahar Mangesh
1886	Paradkar, Krishnarao Narayanrao
1887	Joshi, Vishnu Bajirao†
1888	Vhanrao, Mahadeo Mallarjun†
1889	Faqir Singh
1890	Radha Krishna Murty, Akella†
1891	Biswas, Samar Kumar
1892	Nagendra Rao, Pokala Ramakrishna Venkata†
1893	Godbole, Prabhakar Damodar†
1894	Botharia, Nand Kishore†
1895	Bihal, Sohan Singh
1896	Govindarajan, T. P.
1897	Basu, Chandra Nath†
1898	Renganathan, Srinivasaiyengar†
1899	Ramaswamy, Srinivasaiyengar†
1900	Sivaramakrishnan, P. M.
1901	Maity, Chandra Kanta†
1902	Balasubrahmanyam, Jagarlapudi†
1903	Waiker, Panduranga Sreenivasacharya†
1904	Roy Barman, Bhupati Bhusan
1905	Selvaraj, Ratnavel
1906	Roy, Deba Prasad
1907	Ponkshe, Sharad Krishna
1908	Randad, Badrinarayan Laxminarayan†
1909	Balshis Singh†
1910	Kota Subba Rayudu, Pinjala†
1911	Siddiqui, Mohammad Rizwanuddin
1912	Chawla, Desh Bandhu†
1913	Sat Prakash†
1914	Vaidyanathan, Swaminatha†
1915	Jatkar, Shivaram Laxman†
1916	Swamy, Tirupati Narayana†
1917	Pathak, Laxman Kashinath
1918	Balakrishnan, Kunjithapatham†
1919	Dutta, Sunil Kumar†
1920	Ray, Dilip Kumar†
1921	Balakrishna, Perunkulam Raghavan†
1922	Hakim Singh, Sub.-Lt. Mahandwan†
1923	Punwani, Hiro Tulsidas†
1924	Prasad, Ram Ekbal†
1925	Khare, Damodar Anant†
1926	Singh, Gurdayal†
1927	Sen, Barun Kumar
1928	Panda, Mukul
1929	Shome, Probhat Kumar†
1930	Nanda, Raj Kumar
1931	Sanyal, Amitava†
1932	Raghavan, Bhuvarahan†
1933	Bhatla, Raj Kumar
1934	Goel, Suraj Parkash†
1935	Ahire, Tulashiram Nathu†
1936	Bandyopadhyay, Nirmal Kumar
1937	Garg, Brij Mohan
1938	Chopra, Rajinder
1939	Goyal, Krishan Baldev†
1940	Prabhakar Rao, Saligram Narayanrao†
1941	Sengupta, Asok Kumar
1942	Gupta, Mahesh Swaroop†
1943	Chakrapani, Rangaswami
1944	Mulchandani, Chandru Tejumal†
1945	Purushotham, Salla Kanniah
1946	Pankajakshan, E. P.†
1947	Avinashi, Anand Krishan†
1948	Gandhi, Nand Lal†
1949	Banerjee, Ajit Kumar†
1950	Seshadri, Sub.-Lt. Ramakrishnan
1951	Pathak, 2/Lt. Girija Shanker†
1952	Murthy, Mandalaparthy Parabrahma†
1953	Grover, Rajendra Paul†
1954	Nigam, Hridaya Narain
1955	Kasturi Rangan, Vangeepuram Canchi
1956	Chetal, Ved Parkash
1957	Motafram, Adil Sorabji
1958	Sundararamaaiyar, Sivaramakrishnaiyer†
1959	Madhavan, Karur Srinivasan
1960	Subramanian, A. Mrithyunjayaiyer†
1961	Gupta, Anand Prakash†
1962	Paul, Jogesh Chandra†
1963	Seshadri, Grama Srinivasaiyengar†
1964	Dake, Vasant Dattatraya†
1965	Patel, Arvindkumar Ambalal
1966	Verma, Ilam Singh†

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† Transferred from Student.

GRADUATES (*contd.*)

No.	Name	No.	Name
1967	Patel, Kantibhai Gordhanbhai	973	Banerjee, Brajo Gopal†
1968	Ramanuja Chari, Tuppal	1974	Bhatt, Gayatriprasad Hiralal
1969	Bheema Rao, Mirmira Ramarao	1975	Goswami, Ajoy Kanta†
1970	Jain, Satish Kumar	1976	Ghosh, Atul Prasanna†
1971	Nehra, Raj Pal Singh†	1977	Bagga, Kuldip Singh†
1972	Srinivas, Ramanujapuram Anandampillai	1978	Srinivasarangan, Tirumalai Thattai†

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Mr. P. S. E. Jackson

Mr. Philip Sydney Edward Jackson, M.I.E.E., M.I.W., M.I.E., died on March 9, 1963, at Farnham, Surrey, England, at the age of 75. He was Member for Life of the Institution. He was one of the first members of the Institution and had a long and distinguished association with it.

He was born in Mitcham, London, in 1887, and educated at St. John's, Leatherhead. Mr. Jackson was apprenticed at Crompton's Works, Chemlsford, where he trained to be an electrical engineer. He had a special fair for diagnosing electrical faults and when a Crompton plant in Madras developed some faults, he was sent there to inspect and rectify the plant. Having completed this work, he was subsequently engaged by Siemens Bros. in their Madras branch. Later he became General Manager for the English Electric Co. in India, and when they decentralized, he became Chief Engineer in India for the General Electric Co. with headquarters in Calcutta. After 27 years of service in India, he retired in 1937, and set up an electric business of his own, *viz.*, Max Electric Co., Ltd., at Thornton Heath in England, which he later transferred to Waltan-on-Thames. He retired from professional practice in 1956.

Mr. Jackson was a founder Member of the Institution.

Shri F. S. Chenoy

Shri Faridoon Sohrabji Chenoy, B.Sc. (Eng.), M.I.E., died on March 20, 1963, at the age of 69.

Born in 1894, Shri Chenoy had his general education at the Northern University, Manchester, up to 1913 and obtained his B.Sc. (Eng.) degree from the Victoria University, Manchester. He joined the Nizam's P.W.D. in 1918 as Assistant Engineer and was promoted to Divisional Engineer in 1925, and subsequently, he became Chief Engineer in 1942. Shri Chenoy was responsible for the remodelling and running and maintenance of the Hyderabad Waterworks, which was then one of the most up-to-date water supply systems in India. He was also responsible for the design and construction of six minor independent water supply systems, involving the construction of infiltration galleries, rapid gravity, pressure and slow-sand filters, pumping stations, service reservoirs and tanks and pipe distribution systems.

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† Transferred from Student.

Shri Chenoy joined the Institution as Associate Member in 1930 and was transferred to Member in 1942.

Shri Mahtab Rae

Shri Mahtab Rae, B.A., A.M.C.T., M.I.E., died at New Delhi, on October 9, 1963, at the age of 79. He was a Member for Life of the Institution.

Born in 1884, Shri Rae obtained his general education from the Punjab University. He obtained his technical education from the Victoria University during 1913-15. In 1916 he was appointed Municipal Engineer of Bareilly in which post he continued till 1932. After retirement from service, Shri Rae worked as Consulting Engineer.

Shri Rae joined the Institution as Member in 1920.

Shri Jagat Singh

Shri Jagat Singh, B.Sc. (Eng.), M.I.E., died in August 1963, at the age of 62.

Born in 1901 at Benares, Shri Jagat Singh obtained his B.Sc. (Eng.) degree from the Benares Hindu University in 1924. After spending one year as Demonstrator in Mechanical Engineering, Maclagan Engineering College, Lahore, and one year as Engineer-in-Charge, M.D. Cotton Ginning and Pressing Factory, Hansi, Shri Singh went to Burma in 1926 and worked as Senior Lecturer and Officer-in-Charge of Workshops and Stores, Government Technological Institute, Insein, Burma, till 1942. During 1942-47, he worked as Chief Inspector of Boilers in Punjab and the North-West Frontier Provence. He went to Burma again in 1947 and was appointed as Superintendent and Works Manager, Polytechnic Training Centre, Rangoon. On his return to India in 1950, he joined the Benares Hindu University as Assistant Professor. In 1957, he joined the Thapar College of Engineering and Technology, Patiala, as Superintendent of Workshops which post he held till his death. During his professional career, Shri Singh was responsible for the set-up of some engineering laboratories in technical institutions in India and Burma and the erection of a pumping set at Benares.

Shri Jagat Singh joined the Institution as Associate Member in 1944 and was transferred to Member in 1958.

CORRIGENDUM

TO VOL. 13, NO. 2; OCTOBER 1963

Page 49, instead of '40457 Nonvinkere Srinivasaiyengar Gopa', please read '40457 Nonvinkere Srinivasaiyengar Gopal'.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

ELECTRICAL ENGINEER, B.Sc. (Hon.), M.Sc. (Tech.), A.M.I.E., aged 31 years, with 7 years practical experience in the works of a British engineering firm (including 6 months higher training in the U.K.) in assembly and testing of electrical equipments; at present working as Foreman in assembly section employing more than 100 workers, seeks change for betterment. Present monthly income (gross) Rs. 1,100 (approximately) which includes D.A. and bonus. (Office ref. E.S. 135)

ELECTRICAL ENGINEER, B.Sc. (Eng.), A.M.I.E., holder of Electrical Supervisors' Certificate of Competency, both West Bengal and Bihar; Examiner of Electrical Supervisor's Certificate of Competency of West Bengal. Fifteen years experience in teaching as Principal of a Technical School in West Bengal under the management of Andrew Yule & Co. Ltd., 30 years of experience in H.T. and L.T. industrial and domestic electrical installations of all types, including generation of power at Andrew Yule's township and other towns in Bengal, Bihar and Assam in very responsible positions, seeks suitable position of responsibility immediately. (Office ref. E.S. 143)

ELECTRICAL ENGINEER, B.E.E., A.M.I.E., age 39 years, 13 years service experience in design and development at the works of a reputable British engineering firm (excluding 2½ years Graduate Apprenticeship course); successfully developed several electrical equipments indigenously; at present engaged in the development of arc melting and heat treatment furnaces. Wishes change in a senior executive position with a minimum salary of Rs. 1,500 per month. Present monthly income Rs. 1,100 (approximately) excluding bonus. (Office ref. E.S. 144)

CHARTERED ENGINEER, double graduate in engineering, mechanical and electrical; corporate member of several professional institutions, with over twenty-three years versatile experience of heavy and light engineering industries such as ship repair, light and heavy machine tools manufacture, repair and maintenance of electrical, Diesel and motive power equipment, familiarity with workshop manufacturing processes including dies and press tool work, production planning, factory administration and stores administration, age 48, initiative, integrity and foreign training. Present income over Rs. 1,800; Bombay area preferred. (Office ref. E.S. 145)

SALE OF QUESTION PAPERS OF THE INSTITUTION EXAMINATIONS

The Institution has appointed Messrs. Naba Mudran (P.), Ltd., 170A Acharya Prafulla Chandra Road, Calcutta-4, as sole agents for the reprinting and selling of question papers of the Studentship and Sections A and B of the Associate Membership Examinations with effect from November 1963. **Students and intending buyers should contact them and remit the cost to them directly.**

The question papers are available at the rates indicated below.

Studentship Examination	.. Rs. 0.50 per set

Question papers of Sections A and B examinations (Old Scheme)

Section A	.. Rs. 2.00 per set
Section B	.. Rs. 2.00 per set

Question papers of Sections A and B examinations (New Scheme)

Section A (set of eight papers)	.. Rs. 2.00 per set
Section B (per set per branch of engineering, *i.e.*, Civil/Mechanical/ Electrical / Chemical / Metallurgy/ Electronics and Telecommunication)	.. Rs. 2.00 per set

All remittances should cover postal charges. The postal charges for one set of papers is 35 nP.. If the set is desired to be sent by registered post, an additional charge of 55 nP. will have to be paid.

Form 362

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1964 Examinations

General information and instruction to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961; and 58th Meeting, Resolution 10, 13th and 14th October, 1961.

(1) The next Studentship and Associate Membership (Sections A and B) Examintions will be held from Monday, May 4, 1964 to Monday, May 11, 1964, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examination and the programme of examinations are attached to this *Bulletin*.

(2) **All applications accompanied by examination fees for admission to the May 1964 examinations should reach the Head Office before 4 p.m. on Monday, March 16, 1964.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidates is specially drawn to item 4 in Form 304 (rev. 8) and item 5 in Form 305 (rev. 7) in this regard. The instructions for making such payment are given in card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

(4) No application for a change of examination centre will be entertained after 4 p.m. on Monday, March 16, 1964.

(5) Students who are in arrears of subscription will not be admitted to the examintions.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 11.2.1 to 11.2.9 of the rules of examinations (see 'Rules and Syllabuses of Studentship and Associate Membership Examinations') should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B on payment of an examination fee of Rs. 30.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

(10) The paper in 'Engineering Drawing II' is of 5½ hours' duration, with a half-hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(11) Section B candidates should specially note to write down on the cover of their answer-books of the paper in 'Engineering Drawing II' the names of their particular sections, *viz.*, structural steelwork or reinforced concrete or machines or electrical or chemical plant.

(12) **Candidates are not permitted to use handbook(s) for the paper in 'Engineering Drawing II'. They may however use steel tables of the Dorman-Long type.**

(13) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(14) Candidates reappearing in subject(s) in which they have already secured exemption(s), will have their paper(s) cancelled. The previous exemption(s) will stand.

(15) It is sometimes found that candidates do not enter their Studentship Number/Studentship Application Reference Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(16) **The results of the May 1964 examinations will be declared before the last day of August 1964.**

(17) Applications for revaluation of answer-books will not be entertained.

(18) The marks of each examination will be communicated to candidates along with results free of charge.

(19) **The Institution reserves the right to cancel the result of any candidate without assigning reasons, in which case, the marks will not be supplied.**

(20) In any future correspondence in regard to the May 1964 examinations, candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in May 1964.

THE INSTITUTION OF ENGINEERS (INDIA)
8 Gokhale Road, Calcutta 20
May 1964 Examinations
Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Studentship Examination	
Monday, May 4, 1964	English	Mathematics I
Tuesday, May 5, 1964	Mathematics II	Physics
Wednesday, May 6, 1964	Chemistry	
	Associate Membership Examination—Section A	
Monday, May 4, 1964	Mathematics I	Mathematics II
Tuesday, May 5, 1964	Applied Mechanics	Principles and Applications of Heat, Light and Sound
Wednesday, May 6, 1964	Principles and Applications of Electricity	Theory of Structures and Strength of Materials Theory of Machines Elementary Electrical Engineering Applied Chemistry Physical Chemistry and Organic or Inorganic Chemistry
	Associate Membership Examination—Section B	
Monday, May 4, 1964	Engineering Materials	Engineering Drawing I
Tuesday, May 5, 1964	Engineering Drawing II (from 10.00 a.m. to 1.00 p.m. and 1.30 p.m. to 4.00 p.m.)	
Wednesday, May 6, 1964	Theory and Design of Structures Diffusional Processes, Evaporation and Distillation Chemical Works Organization and Management	Electrical Engineering Genera Geology Fuels and Combustion
Thursday, May 7, 1964	Irrigation Water Supply and Sanitary Engineering Hydro-Electricity Agricultural Engineering Machine Design Mining Metallurgy Mechanics of Fluids	Thermodynamics and Heat Engines Metallurgy Transport and Storage of Materials Principles of Heat Transmission and Furnaces Soil Mechanics and Foundation Engineering
Friday, May 8, 1964	Workshop Technology Engineering Chemistry Electrical Installations Electrical Measurements Electric Traction Ultra-High Frequency Technique Including Radar and Centimeter-Waves Electro-Chemistry Industrial Stoichiometry	Building Construction Stability and Resistance of Ships Gas Engineering Principles of Mining Metrology and Machine Tools Electricity Supply Instruments and Automatic Control in Chemical Industry Chemical Works Design and Construction Size Reduction, Mixing and Separation
Saturday, May 9, 1964	Hydraulics and Hydraulic Machinery Roads Town Planning Harbours and Docks Architecture Line Communication Railways Power Generation and Distribution in Chemical Works	Electrical Machinery Geodesy Radio Communication Principles of Heat Transmission, Heat Transfer Equipment, and Refrigeration Materials and Mechanical Construction of Chemical Plants
Monday, May 11, 1964	Industrial Engineering and Management	Refrigeration and Air-Conditioning Aeronautics

Form 362

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1964 Examinations (New Scheme)

General information and instructions to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th - 29th June, 1961, and 58th Meeting, Resolution 10, 13th and 14th October, 1961).

(1) The next Associate Membership (Sections A and B) Examinations (new scheme) will be held from Monday, May 4, 1964 to Saturday, May 16, 1964, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examinations (new scheme) and the programme of examinations are attached to this *Bulletin*.

(2) **All applications accompanied by examination fees for admission to the May 1964 examinations should reach the Head Office before 4.00 p.m. on Monday, March 16, 1964.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates, locality. Attention of the candidate is specially drawn to item 3 in Form 363 and item 5 in Form 364 in this regard. The instructions for making such payment are given in Card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

(4) No application for a change of examination centre will be entertained after 4.00 p.m. on Monday, March 16, 1964.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 11.2.1 to 11.2.9. of the rules of examinations (see 'Rules and Syllabuses of Studentship and Associate Membership Examinations') should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B (new scheme) on payment of an examination fee of Rs. 50.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

A candidate may also appear in one complete branch of engineering on payment of usual examination fee of Rs. 75.00. Rules of examination for such a candidate will be identical with those applicable to regular candidates.

(10) Candidates are not permitted to use handbook(s) for the paper in 'Design and Drawing' of Section B. They may, however, use steel tables of the Dorman-Long type.

(11) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(12) It is sometimes found that candidates do not enter their Studentship Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(13) The results of the May 1964 examinations (new scheme) will be declared before the last day of August 1964.

(14) Application for revaluation of answer-books will not be entertained.

(15) **The marks of each examination will be communicated to candidates along with results free of charge.**

(16) The Institution reserves the right to cancel the results of any candidate without assigning reasons, in which case, the marks will not be supplied.

(17) In any future correspondence in regard to the May 1964 examination (new scheme) candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in May 1964.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

May 1964 Examinations (New Scheme)

Programme

Days	**S.T. 10.00 to 1.00**	**S.T. 2.00 to 5.00**
	Associate Membership Examination—Section A	
Monday, May 4, 1964	Mathematics I	Mathematics II
Tuesday, May 5, 1964	Applied Mechanics	Principles and Applications of Electricity
Wednesday, May 6, 1964	Heat, Light and Sound	Engineering Drawing
Thursday, May 7, 1964	Strength of Materials	Elementary Surveying
	Associate Membership Examination—Section B	
Monday, May 4, 1964	Materials and Construction Mechanical Engineering Materials Electrical Engineering Materials Chemical Engineering Materials Principles and Practice of Coal Mining Mineral Dressing Electronics and Telecommunication Materials	Theory and Design of Structures Industrial Organization and Management Theory and Performance of Electric Machines Industrial Stoichiometry and Mechanics of Fluids Principles and Practice of Metal Mining Physical Metallurgy and Physical and Mechanical Testing of Metals General Electrical Engineering
Tuesday, May 5, 1964	Structural Engineering Hydraulics and Hydraulic Machinery Generation, Transmission and Distribution of Electric Power Diffusional Processes, Evaporation and Distillation Mine Ventilation, Explosions, Fire and Inundation Refractories Applied Electronics and Circuits	Surveying and Geodesy Theory of Machines Electric Traction Fuels and Combustion Mine Surveying Foundry Engineering Transmission Lines and Net-Works
Wednesday, May 6, 1964	Hydraulics Industrial Engineering Illumination Engineering Elementary Electrical Engineering Mineral Dressing Practice Metallurgical Analysis Advanced Radio and Electronic Engineering	Irrigation Engineering Refrigeration Line Communication Gas Engineering Mining Geology Industrial Metallurgy Antenna and Wave Propagation
Tuesday, May 7, 1964	Civil Engineering Design and Drawing Mechanical Engineering Design and Drawing Electrical Engineering Design and Drawing Chemical Engineering Design and Drawing Electronics and Telecommunication Design and Drawing	(From 10 a.m. to 1 p.m. and 1.30 p.m. to 4 p.m.)
	Mining Machinery Physics of Metals	Generation, Distribution and Utilization of Power in Mines Metallurgy of Less Common Metals

Programme—(*Contd.*)

Friday, May 8, 1964	Architecture	Soil Mechanics and Foundation Engineering
	Air-Conditioning	Aerodynamics
	Radio Communication	Hydro Power Engineering
	Materials and Mechanical Construction of Chemical Plants	
		Metallurgy
		Mine Organization and Management
	Mine Design and Planning	Engineering Metallurgy
	Metallurgical Thermodynamics	Audio Frequency Engineering
	Radio Communication Systems	
Saturday, May 9, 1964	Public Health Engineering	Town Planning
	Railway Locomotives and Rolling Stock	Automobile Engineering
	General Electronics	High Frequency Currents
	Refrigeration and Air-Conditioning	Chemical Works Organization and Management
	Mine Economics	Metallurgy and Assaying
	Electrometallurgy and Hydrometallurgy	Fuels and Furnaces
	Electronic Measurements	Industrial Electronics
Monday, May 11, 1964	Highway Engineering	Harbours and Dock
	Fuels and Refractories	Drilling Engineering
	Radar Engineering and Microwave Techniques	Television
	Workshop Technology	Utilization of Electric Power
		Principles of Heat Transmission and Furnaces
Tuesday, May 12, 1964	Thermodynamics and Heat Engines	Aggricultural Engineering
	Size Reduction, Mixing and Separation	Thermodynamics
	Telegraphy and Telephony	Carrier Current Engineering
Wednesday, May 13, 1964	Metallurgy of Iron and Steel	Geology
	Industrial Administration	Production Technology
		Non-ferrous Metallurgy
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		Heat Treatment of Metals and Alloys
Friday, May 15, 1964	Thermal Power Engineering	Production Technology and Industrial Engineering
	Servomechanisms	Principles of Semiconductors and Transistor Circuits
Saturday, May 16, 1964	Principles of Line and Radio Communication	

CALCUTTA

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THE MANAGEMENT PATTERN IN INDIAN INDUSTRY

F. K. Tangree
Non-member
Centrifugal Development Engineer, Port Engineering Works Ltd., Calcutta

This short paper attempts to shed light on patterns of executive behaviour observed to be prevalent in a number of industries in India, their influence, in many subtle ways, in asphxyiating the initiative of subordinates and accelerating the unhealthy problem of inefficiency wherever such administration exists.

Apart from decision-making, the chief responsibility of management is to assign well-defined authority of responsibility. Often enough, it is found that this is effected in very broad and general terms without accurately spelling out the specific duties, which deprives of clear notion of the responsibility of each position in the structure of management. As a result, the subordinates generally tend to be almost entirely dependent on the executive.

It is not uncommon to find in industry and elsewhere bosses surrounded by groups of inferior co-workers or 'Yes-men', presumably for smooth sailing, and this is usually noticeable in cases where there is a fear of subordinates outshining and attracting more attention and recognition from the superior executives. This trend ushers a phenomenon comparable to Greshem's law of monetary theory, wherein the inefficients drive out the efficients from the administrative sphere or out of circulation and attract the inefficient.

It seems likely that in addition to some historical influences the imperialistic pattern of education in India has given rise to an autocratic class, resulting in the heads of a number of institutions being more or less autocrats.

In such a climate of affairs, many executives in India are prone to :

(i) Promote Parkinson's law of creating artificial jobs artificially rather than delegate precise duties and authority ;

(ii) Judge efficiency by the degree of subservience acceptable to their subordinates ;

(iii) Consider unqualified surrender as the basic qualification for employment, promotion and success ; and

(iv) Foster a system of delegation which, in principle, is work division without the power and authority for its execution. That is, the executives assign all their work, sometimes also supervisory, to their subordinates but withhold the quantum of authority necessary for execution of such jobs.

The resulting influence of this is :

(a) Subordinates tend to develop an escapist tendency in their work ;

(b) They are starved of a sense of belonging to their institutions ; and

(c) They are almost perpetually in search of other jobs or perhaps, become antiquarians of the industry out of frustration.

Hence, it would seem expected to order a halt—in a wide context of national level—to such undermining elements. For healthy industrial growth in India, there is need for cognisance that whilst development of industrial leaders may be rather automatic in a developed country, in a competitive economy self-reliance—within the framework of industry—would be an essential criterion, and to achieve this, delegation of duty and authority must perforce be in consonance with the art and science of industrial management. To arrest escapism and foster independent decision-making among subordinates accent should be on encouraging them to take decisions of their own without censure from their superiors coupled with assurance of tolerance of incorrect decisions

PROPOSED PROJECTS BY THE GLASS AGE DEVELOPMENT COMMITTEE, U.K.*

Aim

This proposed project is for a multistorey bridge across a river—in this case the Thames, is given as an example—although the principle could apply to any major river in a built-up area where the 'free' land offered by the bridge offers a unique opportunity for development, particularly with rising prices of existing building land. This proposition is being put forward by the Glass Age Development Committee, which is convened by Pilkington Brothers Ltd., glass manufacturers, to stimulate creative thought in architecture. It is a practical scheme, has obvious economic potential, and is possible with modern construction methods.

Proposals

The five post-war projects, proposed by the Glass Age Development Committee have been: (i) Soho 2000 A.D. (Fig. 1), (ii) Highmarket (Fig. 2), (iii) Skyport One (Fig. 3), (iv) Motopia (Fig. 4), and (v) Crystal 61 (Fig. 5).

The latest in the series of projects presented by the Committee is the Crystal Span (Fig. 6) aimed to develop the economic potentialities of a bridge as a sub-structure for buildings of all kinds.

The following is an outline of all these, the latest proposition, *viz.*, the Crystal Span being treated a little more in detail.

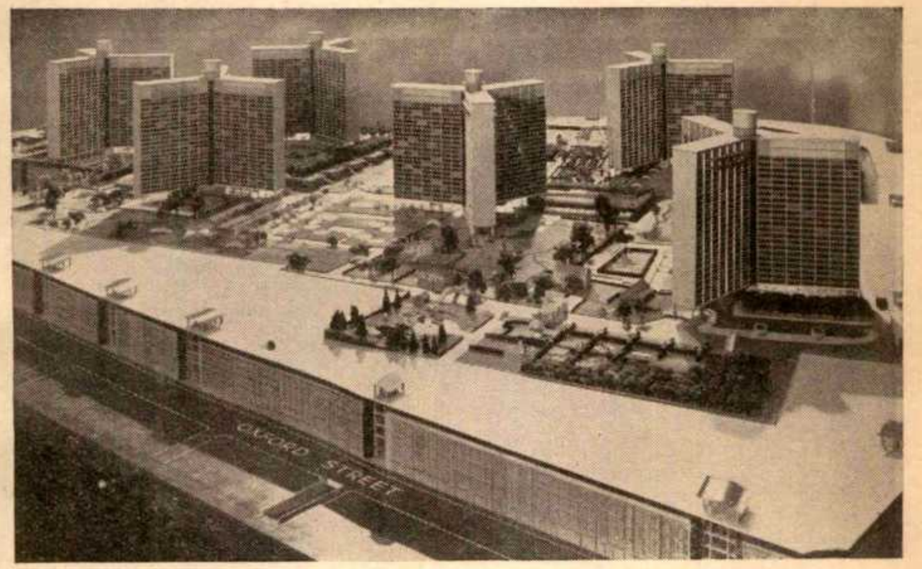

Fig. 1

Soho 2000 A.D.

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*Compiled from publications made available by courtesy of Infoplan Ltd., London.

Soho 2000 A.D.

Soho 2000 A.D. (Fig. 1) was the first post-war scheme of the newly-formed Glass Age Development Committee. Announced in 1955, it proposed a complete redevelopment and modernization of Soho, London, to avoid the congestion which, the committee felt, endangered this area. A feature of the project was the creation of six twenty-four storey blocks of good residential flats within the area of 83 acres where more open space at ground level would then become possible.

Highmarket

Highmarket (Fig. 2), which was announced in 1956, was a scheme to provide a full scale shopping and residential centre for the densely populated Midlands where people usually have to rely on long trips into town for normal services. Four storeys high, and providing over one million sq. ft. of space, the project contained shops, cinemas, a bathing pool, and an exhibition centre as well as parking space for 3,500 cars, lorries and helicopters.

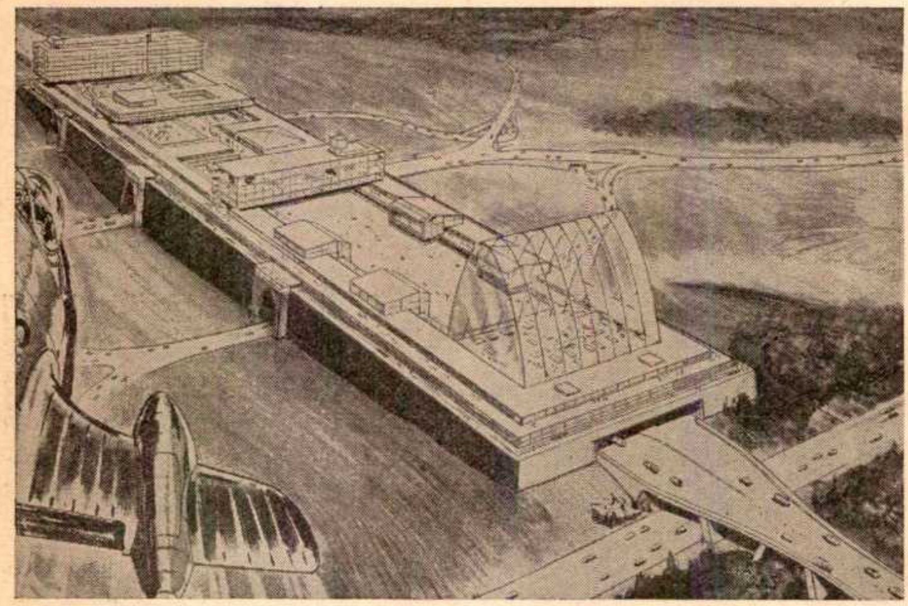

Fig. 2
Highmarket

Skyport One

Skyport One (Fig. 3), which was announced in 1957, assumed that vertical take off and landing of aircrafts would become normal and that helicopters would serve public as well as private commuters. To meet this demand it proposed a large scale helicopter terminal in the form of enlarged roof skyscrapers which could be built in the centre of a city thus avoiding wasteful delays involved with airports distant from the town centre. This particular plan was designed for St. George's Circus, a handy focal point in London's underdeveloped South Bank.

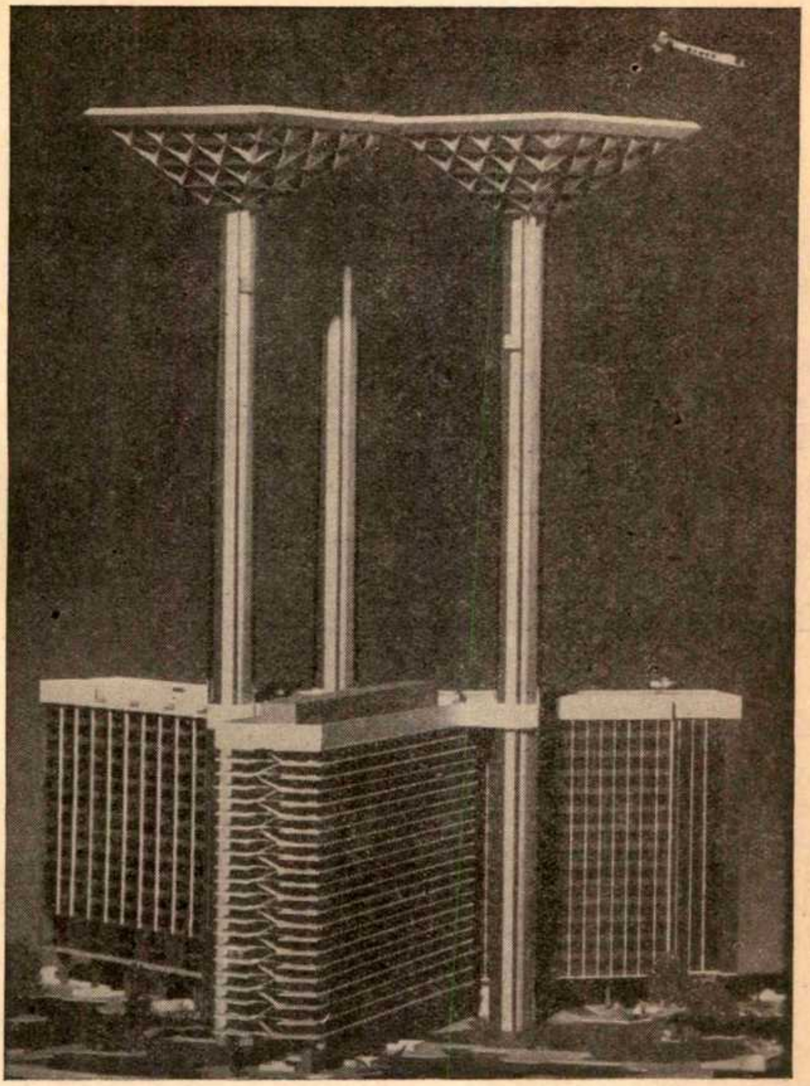

Fig. 3

Skyport One

Motopia

Motopia (Fig. 4), which was announced in 1959, was a revolutionary concept in town planning which completely separated the motor car from the pedestrian in a town for 30,000 people by putting the roads on top of terraced houses arranged in a grid system. The thousand acres which the scheme occupied would be transformed into a giant park containing, in the natural landscape, churches, restaurants, schools, children's playing fields, clubs, and sportsgrounds with normal transport at ground level by water bus on a network of canals and lakes. Estimated cost of the project was £60 million.

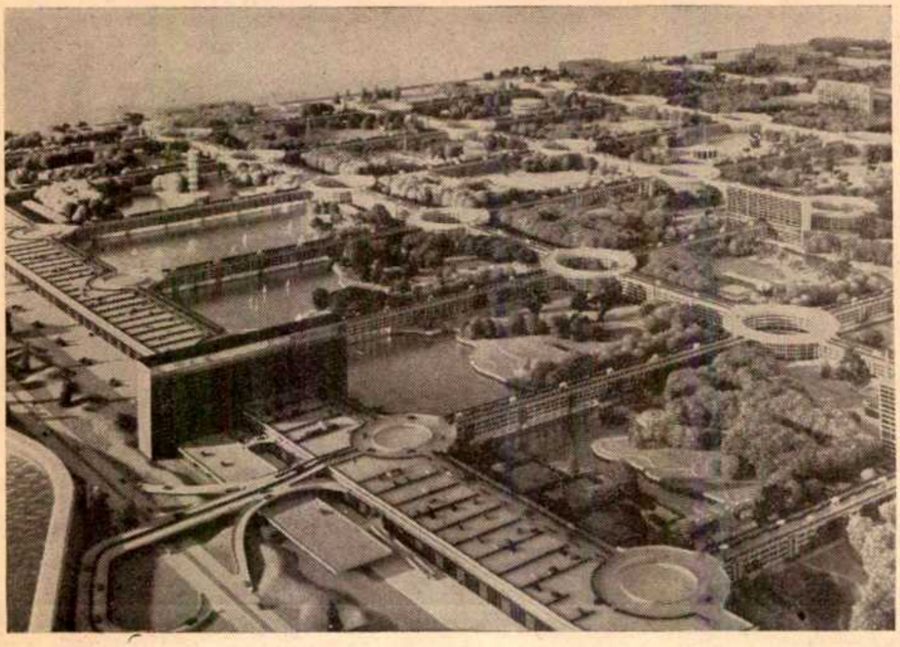

Fig. 4

Motopia

Crystal 61

Crystal 61 (Fig. 5)—a £10,000,000 project devised in 1961—proposed a 1,016 ft. high tower in glass and reinforced concrete which could become a showplace for British industry. Within the tapering glass tower the scheme provided 569,000 sq. ft. of exhibition space in five separate halls, and a total floor area of 934,000 sq. ft. At its widest point the building would be 302 ft. in diameter. The tower contained cocktail lounges, restaurants, cinemas, and a banqueting hall. Parking facilities for 4,500 cars were also provided within the four-floor podium covering the whole of the suggested site just north of Kings Cross Station, London.

Crystal Span—proposed multipurpose bridge

A multipurpose seven-storey bridge containing a hotel, shops, skating rink, theatre, and sculpture gallery is proposed in Crystal Span—the latest project of Glass Age Development Committee (Fig. 6). The suggested site for the £7 million project is as replacement to the existing Vauxhall Bridge across London's River Thames, although the principle could apply to any suitable site across a river in a built-up area. Apart from improving the traffic flow at congested Vauxhall, the multipurpose bridge is a practical economic idea for easy expansion of the limited cultural and recreational facilities along London's potentially superb riverline.

Layout

Basically, Crystal Span would be a three-layer horizontal structure supported on two piers in the river and overhanging the banks at each end.

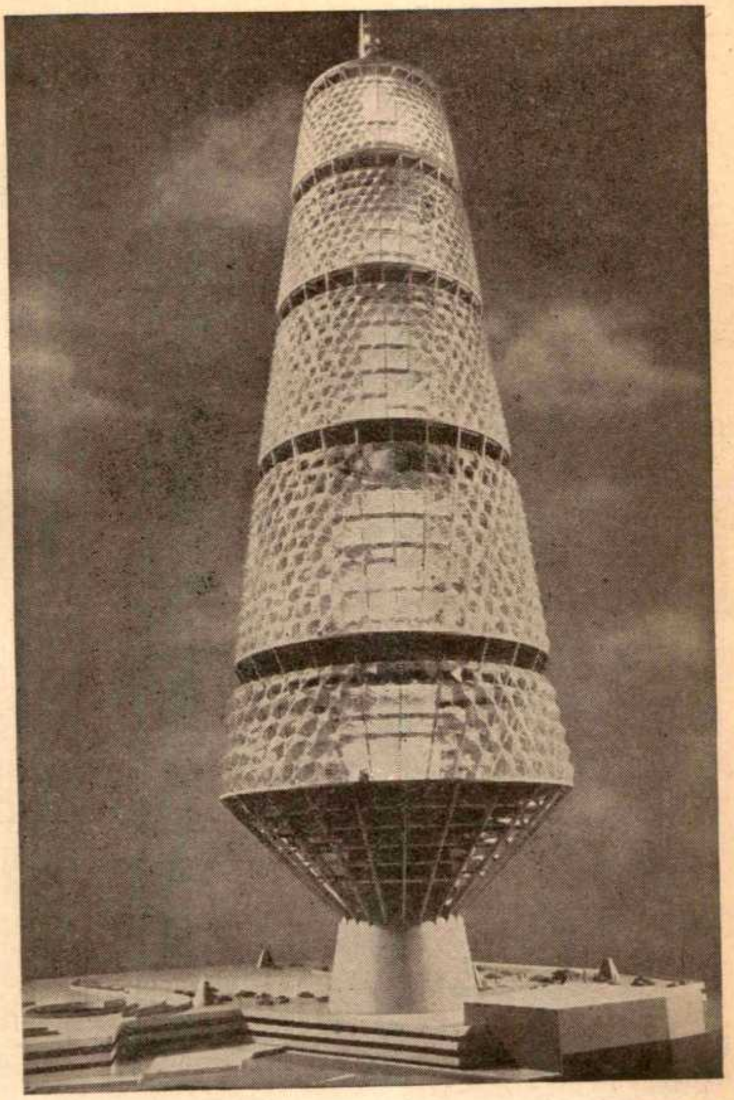

Fig. 5
Crystal 61

Lower level

At the lowest level would be the 6-lane roadway of the new roadbridge itself consisting of two 3-lane 31 ft. 6 in. wide carriageways (with 3 ft. clear on each side) separated by a 14 ft. central reserve housing ducts for services from the buildings above. Immediately above the road level would be a sandwich floor running the whole length of the structure for parking 300 cars. This and the roadway would be contained in one big hollow concrete beam carrying both themselves and the upper

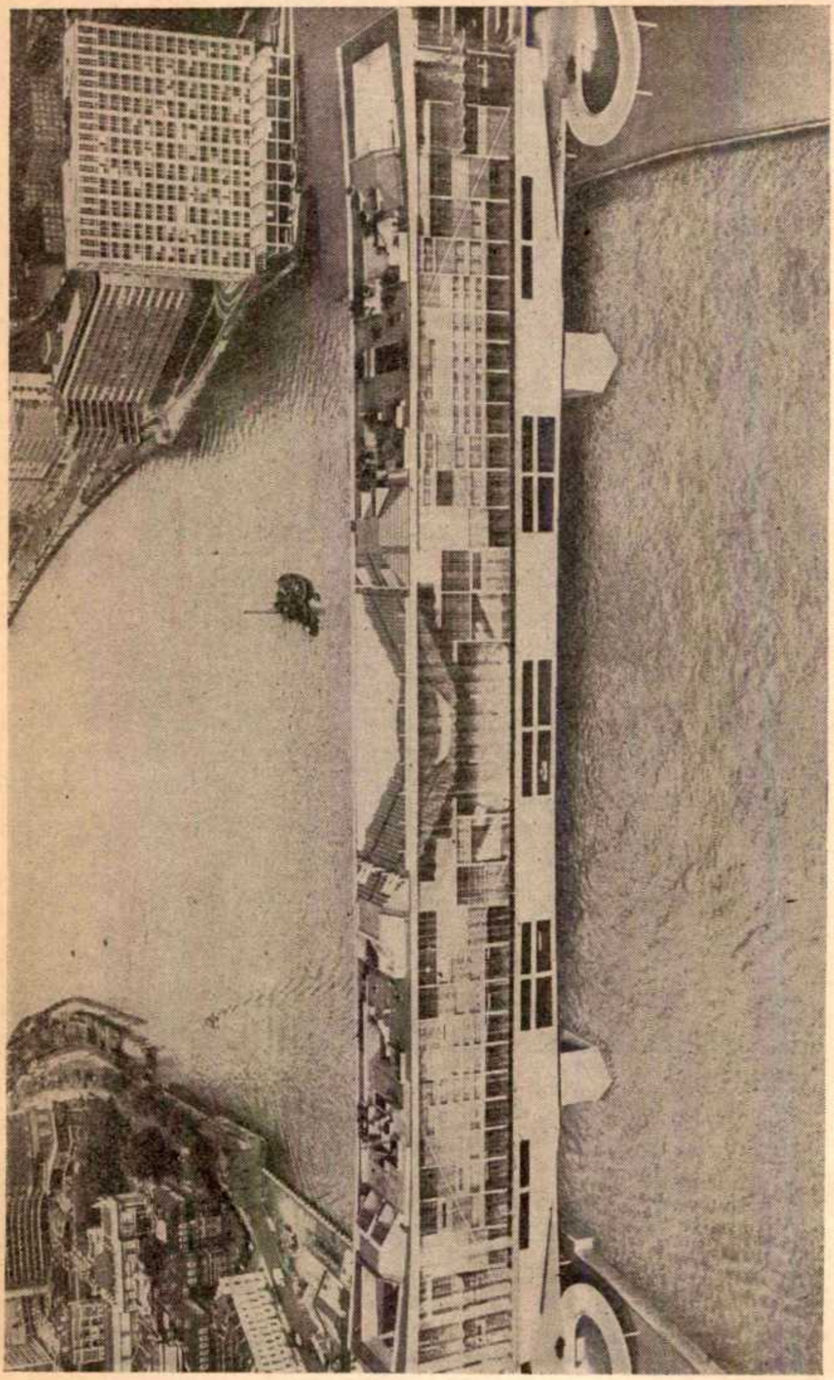

Fig. 6

Crystal Span—a general view of the proposed multipurpose seven-storey bridge buildings. The main carriageway would run straight across the river from bank to bank, and access to the parking floor would be *via* 18 ft. wide one-way ramps to the shore at either end. As pedestrians would be excluded from the roadbridge, walkers across the river would take any of two escalators on each bank which would lead up to the lowest floor, or street, level inside the glass envelope and there, under cover, they would walk across or use one of the moving pavements.

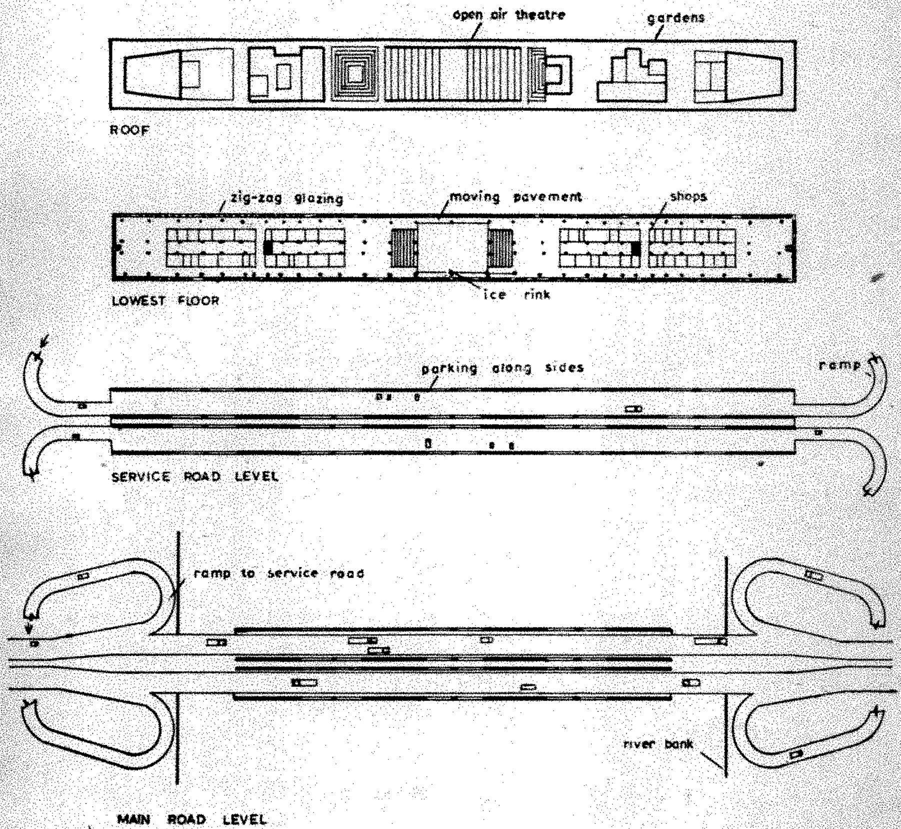

Fig. 7

Crystal Span plans

Middle level

The whole of the middle level of the structure would be enclosed in an 85 ft. high glass curtain zig-zagging right around the building. Within this huge air-conditioned environment the varied and separate functions of the building could be freely arranged without any need for weatherproofing. There is also an extensive open area on the roof to maintain contact with the elements.

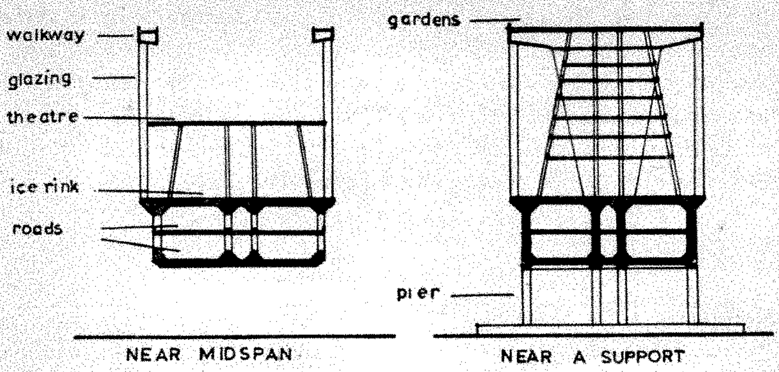

Fig. 8

Crystal Span—cross sections

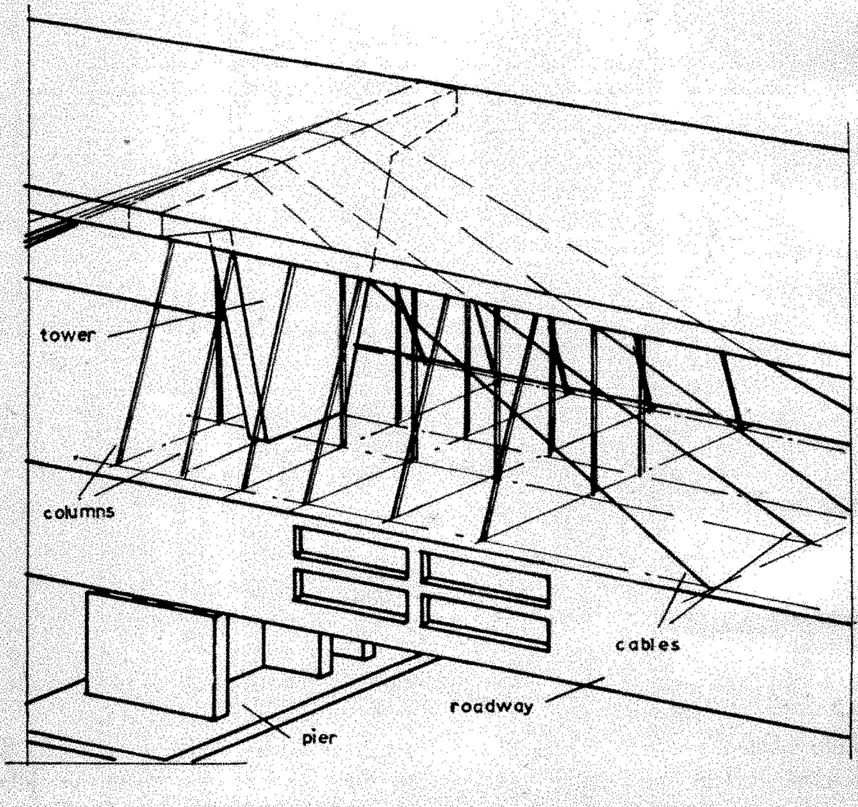

Fig. 9

Schematic diagram of Crystal Span showing arrangement of structure, floors being omitted for clarity

Roof level

Inevitably, being over a river and so high up, the roof of the building would be windy most of the year. So, the different rooftop elements would be so arranged that some of the open viewing platforms would step upwards into the wind, and others would sink out of it in wells to become secluded and sheltered gardens and sitting places.

Structural design and construction

The bridge would consist of a pair of double-decked prestressed concrete box sections forming the roadway and parking floor and supporting the building above. The box sections would have solid side walls at points of support and open sides at the areas of reduced stress. They would be suspended at four points along the length of the bridge by cables (probably 18 in. in diameter total) running to the top of concrete towers built upwards over each new pier within the height of the building. The first stage in the construction on this particular site would be to remove the two existing side piers and replace these with new ones. The two present central piers coincide with two inner points of cable suspension of the new bridge and would be retained as support during the construction until the cables were positioned and stressed. Then they would be demolished. Once the two new piers were complete and the tops of the remaining two old piers were prepared to receive, temporarily, the new work, the four solid sided portions of the roadway would be built over them. This could be done without much temporary staging or any interference to the traffic flow. Next, the four sections would be joined to each other and to the land by temporary girder bridges, each about 120 ft. long. On these the remaining open-sided roadway sections would be built, probably of precast sections. At the same time the two towers would be built over the two piers. Then the bridge would be prestressed longitudinally to unite the precast units. The tension cables would then be laid over saddles on the top of the tower and attached to the top of the roadways at the four points across the width. These would then be stressed up by jacking under the saddles which would free the bridge from the old piers for demolition. The remainder of the structure could be built in the conventional manner on the upper, parking level, roof. Essentially, it would consist of four longitudinal rows of columns supporting the floors and roof.

Suspended glass envelope

The glass curtain surrounding the whole building would be a zig-zag of 'Armourplate' toughened glass sheets hanging in vertical courses downwards from the top of the building. Because, in such a suspended glass assembly, each sheet is carried by bolts on to the one above and finally by hangers from the top of the topmost course into the building itself, all glazing bars and frames of any sort are eliminated. The only other materials used apart from the small fixing bolts for each panel are extruded clear plastic strips to weatherproof the curtain at the joints between each glass sheet. The glass curtain would be 85 ft. high and it would be one of the biggest, if not the biggest, clear glass wall ever to be projected. The zig-zag plan of the glass (the sheets are 8 ft. wide, and each width forms a zig or a zag) is a simple form of bracing the curtain against the wind without the need of other devices. One very significant aspect of the curtain

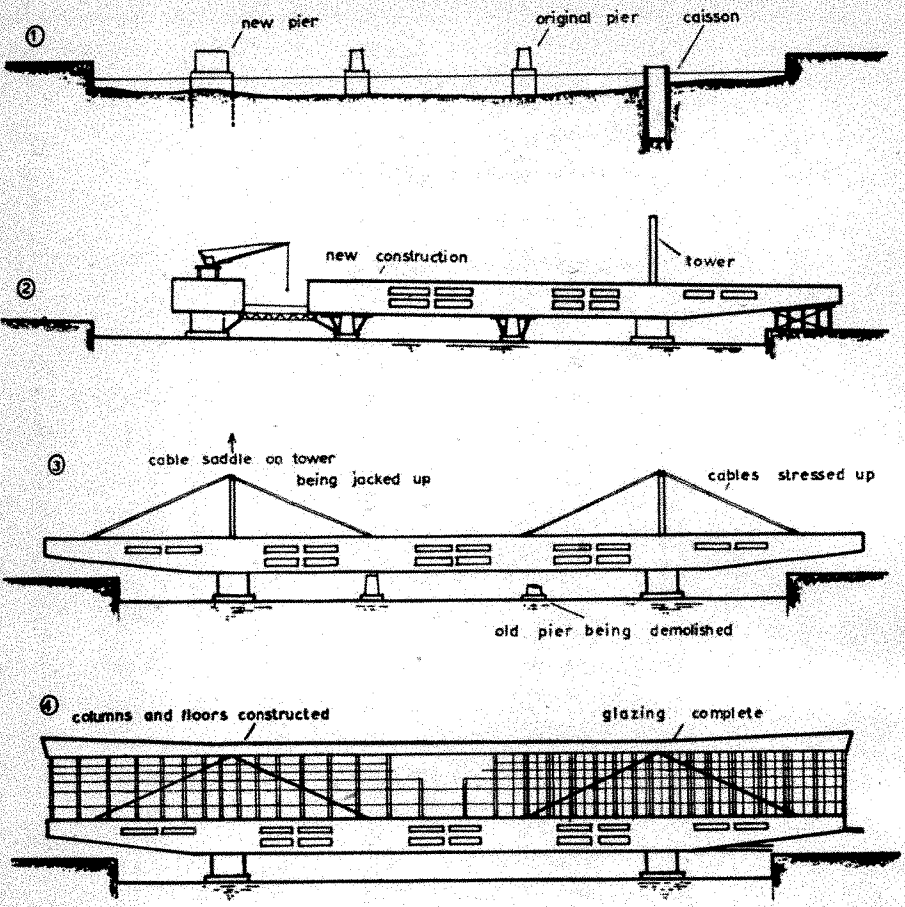

Fig. 10

Crystal Span—stages of construction

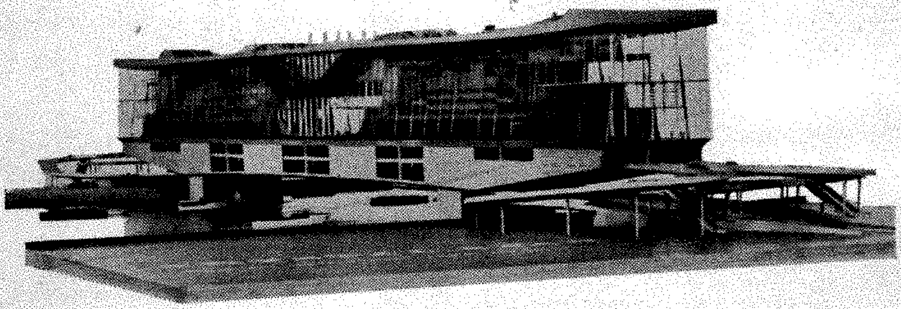

Fig. 11

A model of Crystal Span showing complete structure

is that vertical facets will catch and reflect the light of the sun, from the clouds, from riverside lamps and the water itself and so super-impose upon its transparency a constantly changing pattern of light and glitter in a new form of glass wall.

Some features of the span dimensions

Dimensions proposed in Crystal Span are given below:

Length at superstructure level ..	970 ft.
Width at superstructure level ..	105 ft.
Width at road level ..	95 ft.
Width at each carriageway ..	31 ft. 6 in.
Roadway headroom (centre) ..	16 ft. 9 in.
Roadway headroom (entrance) ..	22 ft.
River headway (centre)—high water ..	31 ft. 6 in.
Width of river between piers ..	492 ft.
Height from Trinity high water	
Superstructure base ..	70 ft.
Walk round perimer of roof ..	153 ft.
Highest platform* ..	165 ft.
Total floor area inside superstructure (*i.e.*, including whole pedestrian concourse level, all accommodation and circulation space above, but excluding all open and space air areas) ..	290,000 sq. ft.

Hotel

A hotel occupies upper floors or superstructure over south pier with main entrance on superstructure base level. It contains 120 bedrooms and suites, each with private bathroom. Every bedroom has a private balcony within the air-conditioned glass 'envelope'. A residents' lounge, restaurant with open-air verandah and cocktail bar with open-air bar are on same level as roof gardens. The second restaurant and ballroom near centre of bridge overlooking skating rink can be used completely separate from main hotel. One kitchen at same floor level services both restaurants.

Restaurants

Two restaurants are situated on same floor level of hotel, one at north end of superstructure, *i.e.*, the main hotel restaurant, and the other occupying gallery level of ballroom.

Sculpture gallery

The sculpture gallery over the northern pier, this is proposed as an extension to the Tate Gallery of Modern Art, and comprises seven interlocking galleries on various levels and the rooftop gallery. The roof top gallery provides 15,000 sq. ft. exhibtion space.

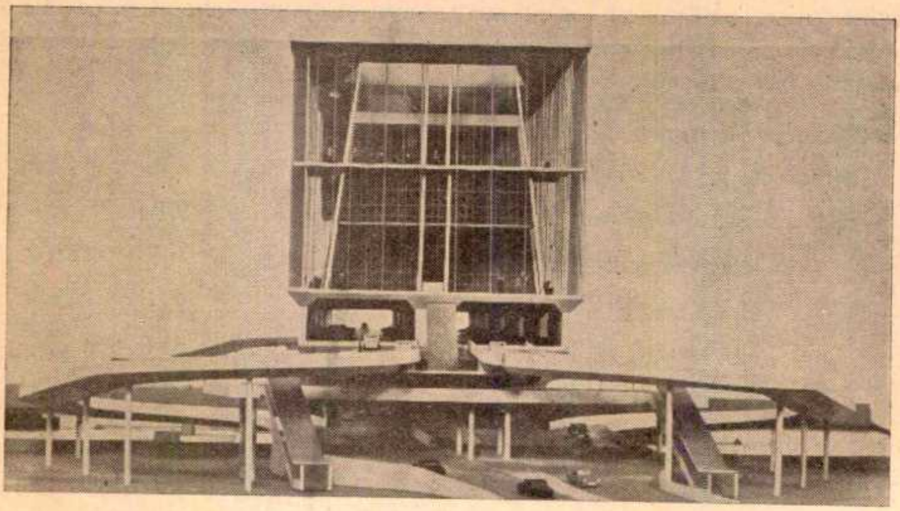

Fig. 12

A model showing entrance to Cystal Span from either shore

Shops

Fifty-two units of shop of 400 sq. ft. sales space each with 18 ft. frontage are contained in a double-row set back under the superstructure over each pier forming arcades behind the columns between the entrance foyers to the accommodation above. Because of internal conditions they would be like market stalls with their fronts without glass.

Theatre

It is formed by a dip in the centre of the concrete roof so that two tiers of 500 seats on each side of the stage are sheltered from wind by exterior glazing. Foyers and backstage rooms are situated beneath the seats. Stage itself can revolve slowly.

Skating rink

Below the theatre is situated the skating rink. It measures 175 ft. × 75 ft. and includes two tiers of 200 seats. A foyer to the changing rooms and a cafe overlooks the floor on the north side at superstructure level.

Roof

The roof is culptured to form a series of gardens, sheltered courtyards and exposed platforms reaching 165 ft. above the Thames. An open-air walk around the perimeter connects all parts.

Lifts

Four groups of lifts linking all levels serve the hotel, the ballroom, the theatre, the skating rink, the roof, and the sculpture gallery. Four separate groups of lifts serve goods access to the shops, the hotel kitchens, the hotel maintenance rooms, and the sculpture store rooms.

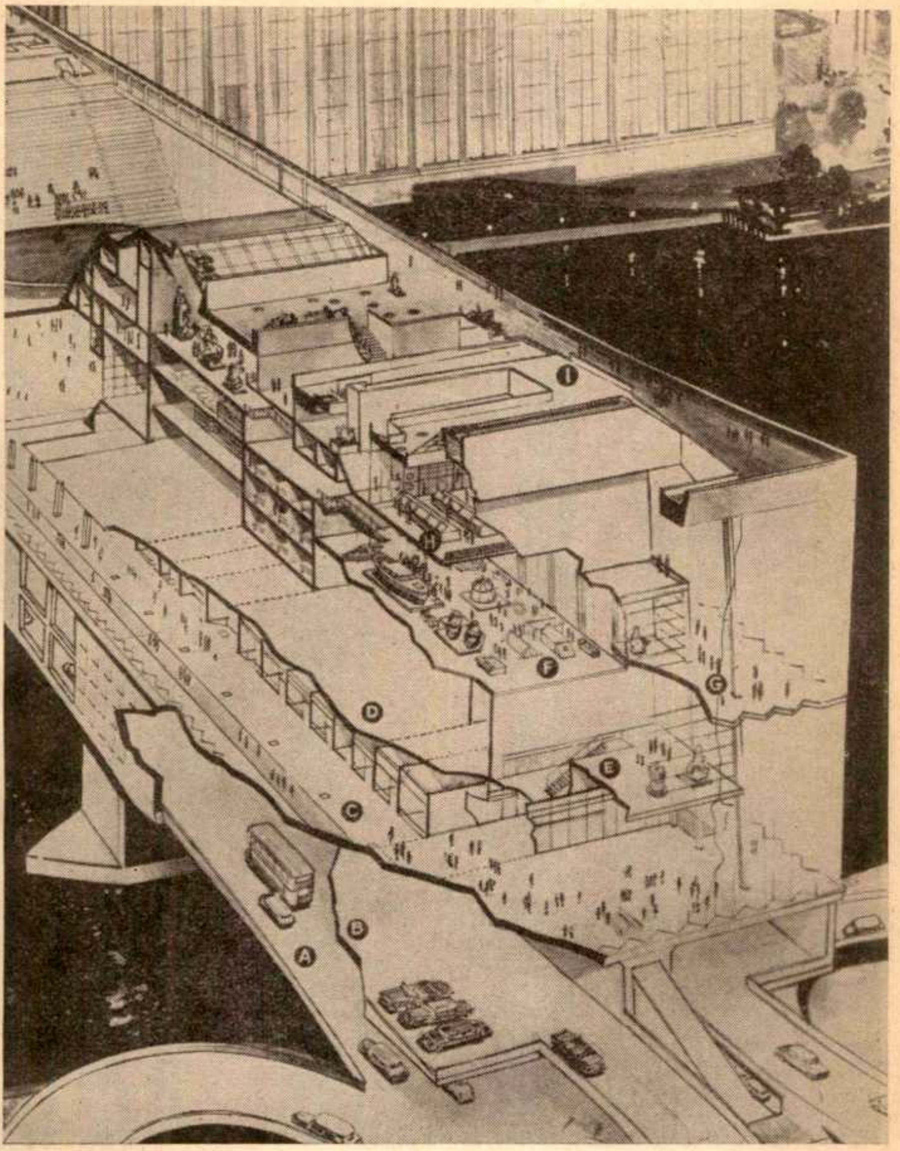

Fig. 13

An artist's impression of a section of the northern part of Crystal Span showing : *A.* The main roadway ; *B.* The service road providing parking accommodation ; *C.* The shopping arcade ; *D.E.F.G.H.* Five of the seven interlocking halls of the sculpture gallery ; and *I.* A viewing platform on the roof

Roads

Contained within the lower level of the base are 2 three-lane carriageways—each 31 ft. 6 in. wide. Immediately above is a service road with parking approached by curving

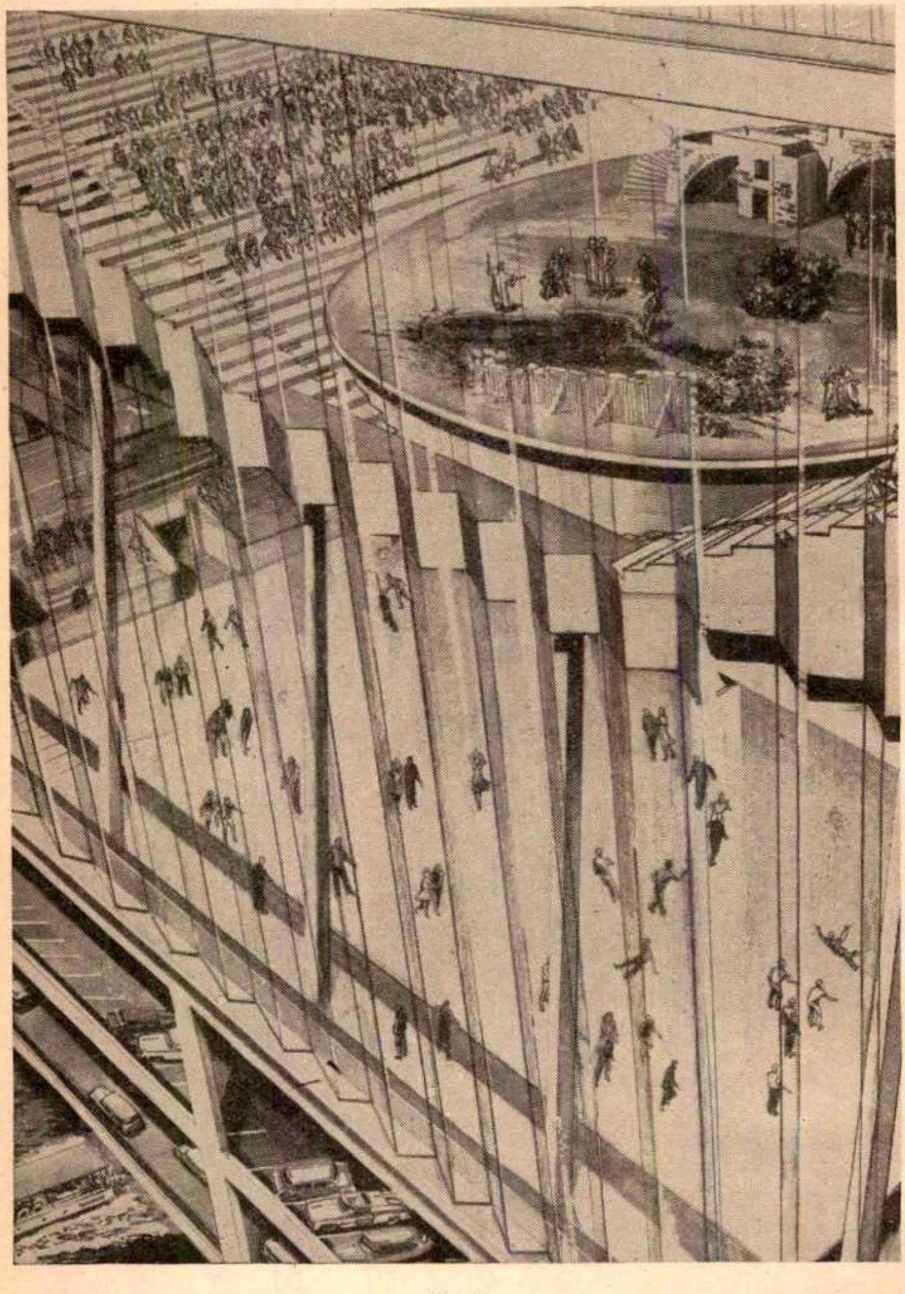

Fig. 14

An artist's impression of the centre of the Crystal Span project from top to bottom one-way ramps 18 ft. wide with a maximum inclination of 1:15 from either shore. Inside there is a two-way access on each side of a central reserve 14 ft. wide housing service ducts and providing eight unloading and U-turn positions.

Parking

Total accommodation for parked cars is 300 along outside edge of service road at right angles to accessways.

Buses

These would cross the river at service road level with stops at each end of the bridge.

Travelator

The travelator stretches from shore to shore at each side of the lowest floor of the superstructure in which the shopping arcade is housed. This would be reached by escalators at each end.

Economics of Crystal Span

If the Crystal Span project were to be built to-day, the total cost would be about £7 million—made up of £3 million for a modern replacement of Vauxhall Bridge and £4 million for the superstructure. Although the civic nature of the site must preclude a purely commercial building, the six floors above the bridge can provide 290,000 sq. ft. of net lettable office space, and 40,000 sq. ft. of net lettable shop space. At £2 per sq. ft. for office space, and £2 10s. per sq. ft. for shop space, an annual return of £680,000 could be expected. As the site does not need to be purchased, the economic returns from a purely commercial building of nearly 10% gross per annum could pay both capital cost and maintenance of the total structure within fifteen years. In its suggested form, the Crystal Span project does contain 52 shops. Each of these has a sales area of 400 sq. ft., and total annual rentals at £2 10s. per sq.ft. would amount to £52,000. Major source of income would, however, be the 120 bedroom hotel, which could produce a net annual revenue of £320,000. Together with income from other amenities, (ballroom, restaurants, skating rink, etc.) it is probable that the project as shown could produce a total revenue of £520,000 or 6% of cost from which could be deducted the cost of maintenance. If a building similar to the superstructure offering such amenities as the proposed Crystal Span project, was to be erected elsewhere in London now, the estimated cost is about £4 million. This figure does not include the cost of the site, whereas by utilizing the open space above a bridge the Crystal Span project offers a unique site free.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Bengal Centre

Chairman's address by Shri S. K. Laha, B.Sc., B.Sc. (Eng.), A.C.G.I. M.I.E., at the Forty-Third Annual General Meeting of the Centre on December 28, 1963

After welcoming the Chief Guest, Shri K. N. Das Gupta, Minister-in-Charge. Public Works and Housing Department, Government of West Bengal, and other invitees, Shri Laha thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering his Chairman's Address, he said, 'The sequence of events which followed the partition of Bengal in 1947 will be recorded in the social history of West Bengal as a tale of unparalleled miseries for its lower middle class. Apart from the influx of millions of uprooted humanity to add to the number of half starved hungry unemployed millions, it adversely affected the economy by tampering with the life-line of the main industries of jute and tea. With such bleak prospects before them, the educated and partly educated youths were embittered by disappointment and misery and were in nodal point of extreme frustration. The despondency and dejection of the half fed and the unemployed, their heart agitated with hate, gave vent to wrath and venom. The rising index of birth rate, the influx of refugees not foreseen, the oft quoted aversion of the middle class, to use hands in preference to head, may sound very cogent reasons to many, but reasons cramped with emotions of a large band of impoverished unemployed lot, refused to analyze the cause. The silver lining of the dark cloud, in such a psychological crisis of unemployment, was etched in the horizon by the one of the noblest sons of the soil, the late Dr. B. C. Roy in taking a firm decision to set up full scale industrial development at Durgapur as an antedote to unemployed educated by opening up zew avenues. With unceasing uncertainties and dwindling resources, planning for production requires companion planning for patience as an aid to understanding, canalising the obstacles in the way of organised effort for the uplift of country's economy and welfare. Because of the rapid increase in population, tending to devour the fruits of normal development, extraordinary efforts are to be made to prevent the sinking of country's economy under the sheer weight of its numbers. So we have to be in a hurry and press into five years the potential of twenty years. We cannot expect our plan to reach its targets with purposeful precision with our foreign exchange critically low, with floods and scarcity of food starting us in the face. Let us therefore plan for patience.

With an ambitious programme for the development of industry, commerce, agriculture, etc., as envisaged in the three successive Plans, it is essential to highlight the importance of transport for the achievement of targets and focus our attention to the inadequacies of transport in our country. Recent Chinese aggression has awakened us from a sense of prolonged diffidence and has spotlighted the drawbacks of our transport system.

In the modern age, it is a truism to say that roads are vital for the development of country. The road system which serves to bridge the gap between urban and rural life, which are an important means of communication for social and economic development, were more or less smoke-screened prior to independence of India for obvious reasons. The massive structure of the nationalized railways side-tracked the development of road and has failed to occupy a position of national importance, *viz.*, the position of railways. The lacuna of road development was pin-pointed by various Committees right from the Nagpur Plan. The India's road mileage of 0.25 sq. mile, as against 3.24 of the U.K., 3.03 of France, 1.00 of the U.S.A., and 0.38 of Ceylon shows the inadequacy of the road system. The roads of a country serve as an index of its development in respect of agriculture, commerce and industry, and the standard of life of people and the pace of road development in a way symbolises the march of India. An all round economic development leading to progress by a sustained growth of national income and progressive rise in the living standard, with larger employment potential, was the base rock on which the successive Plans were founded. Roads and road transport have therefore to play a vital role in the achievement of the objective. Such an expanding economy would no doubt demand more roads and better roads for movement of heavy vehicles but also would look forward to opening up the six lakhs of villages for their sustenance and development. The first post-war road development plan on an all-India basis, popularly known as the 'Nagpur Plan' of 1943, envisaged completion of 123,000 miles of surfaced roads and 208,000 miles of unsurfaced road within a period of 20 years to meet the demands of potential traffic. The objective was to bring every village within 5 miles of a main highway in a well developed agricultural area and within 20 miles in case of undeveloped area. With completion of the First and the Second Five-Year Plans, the targets of overall requirements as provided in the 'Nagpur Plan' have been far exceeded. The table below is a representation of the targets *vis-a-vis* achievements.

	Road length		
	Surfaced (miles)	Unsurfaced (miles)	Total (miles)
Nagpur Plan targets	123,000	208,000	331,000
Position at the beginning of First Five Year Plan	98,000	151,000	249,000
Position at end of the Second Five Year Plan	147,000	294,000	441,000

The target achieved in 10 years shows an increase of 1,92,000 miles over the provision made in the 'Nagpur Plan'. As against provision of 0.26 miles of road per sq. mile as envisaged in the Nagpur Plan, the achievement by end of 1961 was 0.36 miles per sq. mile. So far as West Bengal is concerned, at the beginning of the Plan period with an area of 29,568 sq. miles and population of 21.86 millions, 0.41 miles of road including *kutcha* road per sq. mile for area as against 0.19 of India. At the end of 1960-61, West Bengal had 9,604 miles of surfaced road and 11,532 miles of lower category unsurfaced road motorable in fair weather totalling 21,136 miles. This excludes about 28,000 miles of village *kutcha* roads for cart traffic. This with the present area of 33,440 sq. miles gives a figure of 0.61 miles per sq. mile and with *kutcha* village road it is well over. Thus, the achievement of road works in the State have been no mean but quite conspicuous. However, certain deficiencies like unbridged crossing, sub-standard crust thickness still continue in the network of roads. For the needs of expanding economy, due weightage is being given to plans to overcome this deficiency and the revised Third Five-Year Plan provides Rs. 430 crores for the development of roads both under Central and State Plans as against the original provision of Rs. 250 crores.

For the development of the network of road system, attention was naturally focussed on major trunk roads now known as National Highway, and 14,900 miles of this have been included in the system. At the end of Third Five-Year Plan the programme on National Highways includes construction of 800 miles of missing links, 60 major bridges, 2,300 miles of low grade section (improved), and 900 miles of dual carriage way with an investment of over Rs. 154 crores. The development of village roads mainly connecting more important villages to the market centres was nevertheless lost sight of, but occupied an important place in an agrarian economy. Up to the end of the Second Five-Year Plan, Rs. 23 crores have been spent for development of 12,600 miles of village roads and due weightage to this need was given in the three Plans. In this vast problem, just the fringe has been touched so far. The 20-year Road Development Plan (1961-81) estimated an expenditure of Rs. 1,280 crores for a total rural road mileage of 405,000 miles.

The review of the development of roads on all India basis became imperative after the targets of Nagpur Plan were achieved in 1961. A pattern of road development as a long term measure was evolved in a conference of Chief Engineers (of all States and of Centre) resulting in 'Report of Chief Engineers on Road Development Plan for India'. The production in the country is expected to register a steep rise from 243 million tons in 1961 to 995 millions in 1981; as a result, the long distance traffic of 182 million tons in 1961 will increase to 800 million tons in 1981. The railways which carried 162 million tons in 1961 will be able to cope with 523 million tons in 1981, leaving 277 million tons to be carried by other means, of which the responsibility of road will be 246 million tons in 1961.

The Chief Engineers realizing the needs of the situation formulated a progressively increasing development programme of roads and recommended the following :

Type of road	Mileage during the period			
	1961-66	1966-71	1971-76	1976-81
National Highway	15,600	19,300	24,700	32,000
State Highway	38,500	45,500	56,000	70,000
Major district road	10,000	1,11,000	1,28,100	1,50,000
Minor district road	88,500	1,08,800	1,39,300	1,80,000
Village road	1,63,500	1,77,200	1,97,700	2,25,000
			Total	6,57,000

The estimated cost of such a development is :

Third Plan	..	Rs. 590 crores
Fourth Plan	..	Rs. 1,060 crores
Fifth Plan	..	Rs. 1,550 crores
Sixth Plan	..	Rs. 2,000 crores
Total	..	Rs. 5,200 crores

Such a figure of Rs. 5,200 may appear to be large but when it is realized that this target aims at 0.52 miles of road per sq. mile in 1981 against existing 1.00 per sq. mile in the U.S.A., 2.00 per sq. mile in the U.K., and 3.04 per sq. mile in France, it can only be termed as a comparatively low one.

Even when the target is achieved by spending 5,200 crores of rupees, villages in which developed area would be four miles from a metalled road and 1 mile from any kind of road. In less developed areas they may be 8 to 12 miles from a metalled road and 3 to 5 miles from any road. This surely is not a very ambitious target.

Till receipt of the 'Neogy Committee' report on 'Transport—Planning and Coordination', active consideration of the above 20 years plan was kept in abeyance, but, nevertheless, the same is serving as basis for putting up new schemes in every state. With the rapid strides made in various spheres, the people of India to-day have become definitely road-minded and the relative dependency of the progress of the country on the development of road is fully recognized and accepted.

I would reiterate that the economy, development and defence of our country are inextricably connected with the development of roads, and it contributes considerably towards emotional and cultural integration. It, therefore, stands to reason and all the more necessary that the momentum of road development should be kept in accordance with the need of the country.

Touching on the problem of technical education in India, it is indeed gratifying to watch the rapid increase in the number of educational institutions. Providing facilities for practical training on short and long term basis is an essential 'must' item. In almost all the industrially advanced countries, engineering colleges and research institutions invariably work in close liaison with industry. Research works are done in collaboration with industry. In our country this type of liaison or cooperation between industry and technical educational institutions does not exist in any appreciable degree. It is high time the industrialists of our country realized this and created the healthy liaison and cooperation spirit well realizing that the progress in the field of industry depends considerably on efficient technical talent.

Of late, we hear that the quality of metal in an engineering student has deteriorated. To a certain extent this is true. We have to find out the lacuna. On one hand the teaching in colleges and institutions tends to be too bookish and theoretical, on the other hand, there is reluctance on the part of engineers from industries and services to come forward for a short spell on part time assignments. Likewise, there should be short term exchange of teachers in engineering institutions to industrial firms and government departments. The psychology of these fresh engineering graduate has changed considerably. Eagerness for practical knowledge and experience are fast disappearing. The immediate prospect of a good job with more than one offer, is causing a great impact on quality as survival of the fittest is more or less a thing of the past. I would appeal to all young and budding engineers to reorient their thoughts and form a band of efficient and well trained engineers ready to serve the cause of the country and keep the flag of service before self flying.

From all platforms and by all people in all places, time and again, engineers are complimented as the 'King Pin' of progress and development of the country. The engineers have delivered the goods in all successive plans and their achievements in the recent border emergency have been no mean. Yet the feeling of disgruntlement and dissatisfaction looms large in the faces of most. Their successive efforts to make them active partners in administration of the country have yielded no result uptil now. Their lot of being dictated by unmatured, short sighted and self-centered services in administration is still very unfortunate. Responsibility without power is a misnomer and sooner the Government realises this, the development of the country will make faster strides'.

Summaries of Papers Published in the Journal vol. 44, no. 5, pts. CI 3, ME 3 and ET 2, January 1964

CIVIL ENGINEERING DIVISION

Turbulence Characteristics of Open Channel Flows

Prof. N. S. Govinda Rao
Member
and
N. V. Chandrasekhara Swamy
Non-member

This paper presents experimental investigations conducted in an open channel on the turbulence characteristics of free surface flows, by making use of a hot-film anemometer of the constant-temperature type. It throws light on the behaviour of several turbulence characteristics in open channels when the flow conditions are uniform.

Economic Considerations in the Design of Concrete Structural Elements

Dr. Jai Krishna
Member
and
J. L. Ajmani
Non-member

The requirements of a structural design are not only to sustain the expected forces safely but also to do so economically. Many codes provide to an engineer handy tools by which he can design safe structures. There are a number of factors which are, however, left to the designer's choice, *e.g.*, the type of concrete, the type of steel, the proportioning of dimensions, etc. These factors quite often affect the total cost of a structure substantially. Two designers may design two retaining walls for the same conditions and using the same factor of safety and materials and yet the cost of the two retaining walls may vary considerably. The economic considerations are generally left to the discretion of the designer and this paper attempts to provide information which will help him in excercizing this discretion. Economy has to be exercized in all the three importants stages in an engineering construction, *viz.*, (i) choice of materials, (ii) design, and (iii) construction. It is proposed to consider each aspect separately but main emphasis has been laid on the design aspect of the problem since other considerations are more often governed by factors which are beyond the control of a designer. A few points about other aspects which would depend more upon him than on such factors, have been included.

A Series Solution for Beam Problems

Dr. K. T. Sundara Raja Iyengar
Associate Member
and
S. Anantharamu
Non-member

A series method has been presented for the solution of the problem of bending of beams for all common types of end conditions. The method has been extended to the analysis of continuous beams also. The method is applicable to any arbitrary type of loading on the beams. Cases of beams with variable moment of inertia are also included. Numerical examples are given to illustrate the method.

MECHANICAL ENGINEERING DIVISION

The Phenomenon of Pitting of Gears

S. L. Kanitkar
Associate Member
and
M. B. Modak
Non-member

The phenomenon of pitting of gears is one of the important causes of gear failure. It is distinct from other types of wear in that it is a fatigue failure. Based on the argument that fatigue cracks originate far earlier in fatigue life than when the pitting cracks are actually observed on the surface it is concluded that pitting cracks originate in the body of the material due to maximum shear stress. Design modifications to reduce the susceptibility to pitting as suggested by Walker are discussed and it is concluded that fatigue curves for pitting for both pinion and gear should be reliably known before any such methods could be used effectively.

Heat Transfer in the Internal Combustion Engine

M. L. Lahiri
Non-member
and
K. D. S. R. Somayajulu
Non-member

The heat transfer processes in the various parts of the spark ignited engine are discussed in this paper. A distinction is drawn between the method followed for analysis of the problem and the actual problem. Combustion as a problem and the effect of heat transfer on combustion are discussed. Also, the effect of combustion and knocking on heat transfer are discussed.

Using Mixtures of Refrigerants

V. F. Tchaikovski
Non-member
and
C. P. Arora
Non-member

The idea of using mixtures in the compression refrigerating machines has developed in the last century. Recent researches have shown great promise in the application of mixtures of refrigerants. In this paper a number of schemes such as : (i) non-isothermal refrigeration, (ii) multi-evaporator systems, (iii) low temperature refrigeration, and (iv) other applications of non-azeotropic mixtures of miscible and immiscible agents are discussed.

INDUSTRIAL ENGINEERING GROUP

A Study of the Learning Curve Slopes for Different Industrial Operations

S. Choudhury
Non-member
and
S. K. Basu
Associate Member

This study has revealed that the slope of a learning curve for any industrial operation is independent of the operator concerned. It depends only on the characteristic of the job itself, its constituent operations and corresponding complexities. Complexity can be rated and later used for the computation of the learning curve slope. It has also been found that the manual/machine ratio has an important bearing on the learning curve slope. To use learning curve as a scientific production tool, other factors, besides worker learning, have to be considered. Proper weightage has to be given to each of these factors and the learning curve slope should be later statistically computed. Once all these are known time study is unnecessary for the determination of the learning curve slope.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

One Amplifier for Fourth Order Systems

G. K. Aggarwal
Non-member

This work presents a circuit for simulating fourth order linear systems using a single operational amplifier. One form of such systems is illustrated by taking three simple arbitrary choices of circuit elements. Simulation is possible for only limited range of values of the system's parameters. The circuit can be extended, by adding more laterally inverted L sections, to simulate higher order linear systems.

Galvanomagnetic Effects in Semi-Conductor Diodes

B. S. V. Gopalam
Non-member

The current voltage characteristics of a typical germanium point contact diode having a $\frac{d}{L}$ (thickness to the effective diffusion length) value of 0.2 are measured in both the transverse and longitudinal magnetic fields. The results are compared with the theoretical formula derived by Stafeev which is obtained on the assumption that the magnetic field changes the mobility of the carriers. The theory of Stafeev is extended in the appendix to include the case of photo-injection

Non-Linear Compensation of a Third Order Type-1 Control System

V. Seshadri

Associate Member

There is a generally recognized limit to the degree of optimization of a control system possible by equalizing techniques employing linear components only. Considerable further improvement in optimization can, however, be obtained by introducing simple nonlinearities in the compensating system. The paper describes the results of studies made by introducing the simple nonlinearity as (i) a change in gain, (ii) a change in the lag network, and (iii) a change in the lead network for a typical third order type-1 position control system. The first two methods are seen to be capable of giving a substantial improvement in optimization and also capable of practical application. The last method is found to be comparatively ineffective.

One Operational Amplifier Simulates Fourth Order Systems with Simple Lead

Maj. S. P. Sharma

Associate Member

and

L. K. Wadhwa

Non-member

The paper discusses the simulation of fourth order linear systems with simple lead by a single operational amplifier and a network consisting entirely of resistors and capacitors. The design formulae are given and the circuit component values are computed and tabulated in the text.

INSTITUTION NOTICES

Checking of answer-books of the Institution examinations

It was decided that candidates be permitted to apply for the checking of their answer-books as to whether the marks allotted in the answer-books were added correctly and all the answers within the answer-books were appropriately marked, on payment of Rs. 5 as checking fee.

Candidates wishing this check to be made should apply to the Controller of Examinations within 15 days of the date of posting the results by him. This facility will be available from the May 1964 examinations onwards.

Supply of additional marksheets to candidates

Marksheets are supplied free of charge to candidates after declaration of results of each examination. It has been noticed that a large number of candidates again apply for duplicate marksheets or write for marksheets on the plea of their non-receipt.

It has now been decided that an amount of Rs. 2 be charged for the supply of any additional marksheet to candidates on any reason whatsoever.

List of Referees for Students appearing in Section B of the Associate Membership Examination

Students under the Bengal Centre who wish to be interviewed by Dr. N. N. Roy (E) (printed as item 117, page 23 of the *Bulletin* for October 1963) are informed that they may contact him at the Electrical Engineering Department, Jadavpur University, Calcutta 32, also.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

Draft Indian Standard Specification for Copper Rods for Electrical Purposes (Revision of IS:613-1954)—Doc: SMDC 11 (521).

Members may send their comments on the above Standard before March 15, 1964, to Dr. G. P. Chatterjee (*M.*), Chief Metallurgist, Durgapur Steel Project, P.O. Durgapur Coke Oven, Durgapur, who is the Institution representative on the Sectional Committee dealing with this Standard and copy to Prof. M. V. Deshpande, (*M.*), Chairman, Electrical Engineering Division, Vinayak Cottage, 1170/24 Shivajinagar, Poona 5.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 9 Mathura Road, New Delhi; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 14/69 Civil Lines, Kanpur; or 1/12 First Line Beach, Madras 1.

FORTHCOMING CONFERENCES

Symposium on 'Testing and Evaluation of Materials', Calcutta, March 1964

To commemorate the occasion of the Golden Jubilee of the Government Test House, Alipore, Calcutta, a Symposium on 'Testing and Evaluation of Materials' will be held about the middle of March 1964. During these years, the Test House has been rendering valuable service to the country and industries by way of evaluation of materials and processes, research on industrial problems and methods of testing. The objects of the symposium are given below.

1. Importance of testing and evaluation of materials in the context of economic development of the country
2. Statistical and mathematical approach to testing
3. Non-destructive testing of materials
4. Testing and standardization of electrical engineering materials and appliances
5. Recent advances in the testing and evaluation of boilers and pressure vessels
6. Testing and evaluation of metals—including finished engineering materials

7. Chemical products, consisting of petroleum products and lubricants, ores and minerals, ceramics, paper and paper products, rubber and plastics, leather and paint and pigments
8. Modern physico-chemical methods of testing and analysis
9. Materials for building and road construction and sanitary fittings
10. Textile and aplied materials
11. Precision engineering instruments

Contributions of papers and reviews on subjects keeping in view with the main idea and scope of the symposium are invited.

Further details can be obtained from the Director, Government Test House, Alipore, Calcutta.

Symposium on 'Electricity and Space Heating', London, March 3-4, 1964

The Power Division of the Institution of Electrical Engineers, London, with the collaboration of the Institution of Heating and Ventilating Engineers, is organising a two-day symposium on 'Electricity and Space Heating' at Savoy Place, London, from March 3-4, 1964. The objects of the symposium are to fill in the background against which developments have been made in electrical methods of space heating for domestic and industrial premises and in the control systems used for all methods of space heating, and to bring together the latest information on electrical techniques.

The symposium will open with a review of electrical methods of space heating, and will then survey the general subject under three main heatings: (i) Application and design of electrical heating systems, (ii) Research, design and development, and (iii) Combined heat and electricity generation.

Further information and registration forms may be obtained from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

International Spring Fair 1964, Utrecht, March 9-17, 1964

The Spring Fair 1964 is scheduled to take place on the premises of the Royal Netherlands Industries Fair in Utrecht from March 7 to 17, both dates inclusive. One of the main attractions of the event will be a huge display of machinery and tools for the woodworking and metal industries, the so-called Techni-Show. A new aspect of the forthcoming exhibition will be the sector devoted to natural gas. This stems from the recent discovery of very large quantities of this gas beneath the soil of Holland, and reflects the consequent activity on the part of government and industry alike. The goods to be displayed will be matched to the character of the fair and will include a wide range of machine tools—both hydraulic and pneumatic—and, it is believed, also natural gas apparatus. The technical marine equipment group, which includes combustion engines, will to accommodated on the ground floor of the Marijke hall. There the visitor can take a stroll through 'Foundry Street', the name given to a section of the exhibition comprising some twenty stand of leading Dutch foundries. Lastly in this area will be a large collective display by Italian manufacturers of equipment destined for the shipbuilding industry. The first floor of the Marijke hall will house the new group for hydraulic and pneumatic equipment, to which will be coupled power transmission equipment and materials for supply and control systems Several other equipments of interest will also be exhibited.

Engineering Conference, Canberra, April 13-17, 1964

The Engineering Conference of the Institution of Engineers, Australia, will be held from April 13 to 17, 1964, in Canberra. The tentative programme of the technical session covers the following subjects.

1. Lateral Stability of I-Beams in the Plastic Range
2. Computers in Telephone Traffic Simulation Studies
3. Engineering Standards for an Australia-wide Company
4. High Speed Hard Rock Tunnelling in the Snowy Mountains
5. Preventive Maintenance at Petroleum Distribution Terminals
6. Power Stations in the Latrobe Valley
7. Warragamba Dam
8. Commonwealth Avenue Bridge, Canberra
9. Water Supply Scheme from Avon Reservoir
10. Ground Support Systems for Rocket Vehicle Launching
11. Electrical and Mechanical Design of Poatina Power Station and Switchyard
12. Earthing Design of Electrical Installations in S.M.H.E.A.
13. Design and Behaviour of Tumut 1 and Tumut 2 Pressure Shafts
14. Recent Developments in the Study of Column Behaviour
15. The National Television Service
16. The Electric Shock Tube as a Plasma Source
17. Functional Design of Sewage Pumping Stations
18. Design of the Sydney to Newcas the Expressway
19. Blue Streak Project—Communication System
20. Production of Asphaltic Concrete
21. Lake Burley Griffin Dam
22. A World-wide Automatic Telephone System

Papers on the above subjects will be drawn from all over Australia. As many of these will describe current works and activities in other places, it can be expected that the Conference will cover the interests of all engineers throughout the Commonwealth. Visits and tours will also be arranged for delegates attending the Conference.

Further details can be obtained from The Conference Organiser, The Institution of Engineers, Australia, Box 66, G.P.O., Canberra, A.C.T.

Meeting on 'Stability of Systems', London, May 21-22, 1964

The Automatic Control Group Committee of The Institution of Mechanical Engineers, London, is planning to present a meeting on 'Stability of Systems' from May 21-22, 1964. The aim of the meeting is to stir the interest of applied mathematicians and mathematically minded engineers in unsolved problems of stability, particularly in non-linear systems.

The meeting will be preceded by a tutorial session in the use of Liapounov techniques and will comprise presentations of case studies in four particular problems of control, *viz*., (i) electric power systems, (ii) airborne systems, (iii) chemical systems, and (iv) plasma systems.

Further details may be had from the Head of Groups Department, The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W. 1.

Symposium on 'Commutation in Rotating Machines', London, November 1964

The Power Division of the Institution of Electrical Engineers, London, will hold a two-day Symposium on 'Commutation in Rotating Machines' in London in November 1964.

It is proposed to allocate sessions to the following aspects of the subject

1. Electromagnetic problems
2. Contact phenomena
3. Alternative methods of commutation
4. Design and manufacture of commutating machines
5. Operating experience

The written material for the symposium will comprise contributions of a length not exceeding 1,500 words. Contributions are invited, and synopses not exceeding 200 words in length, with an indication of the probable title, should be sent to the Secretary of the Institution of Electrical Engineers, Savoy Place, London, W.C.2, from whom further details can also be obtained.

Fourth International Conference on 'Underground Town Planning and Techniques of Underground Works', Warsaw, May 1965

The Polish Committee of the International Conference on Underground Town Planning and Techniques of Underground Works in colloboration with the Permanent International Committee of Underground Techniques and Town Planning will organize the Fourth International Conference in May 1965. It is well known since many years that the urban planning is not limited to planning of buildings, streets and green open spaces, that is to the planning on the ground surface only. The necessity of a three-dimensional town planning was claimed many times in the past decades, particularly at the Conferences of underground town planning in Paris (1937), Rotterdam (1948) and Brussels (1959). The specialists of underground town planning of today not only must foresee the necessity of planning the undergrond arrangements or managements but are obliged also to know how the designed works should be executed. These specialists must carefully watch and study the progress in the techniques of underground public works, for the sake that the planning of foreseen buildings and underground nets should be adequate to the needs and possibilities of modern urban techniques.

With a view to meet these objects, the following topics are included in the programme of the conference.

1. *Problems of municipal underground network systems.*
   - (i) Coordination in designing the municipal underground networks ;
   - (ii) Problems of undergrond equipment in connection with trends of modern town planning ;
   - (iii) Municipal underground networks for different kinds of supplying and carrying off in connection with the municipal underground works for traffic ; and
   - (iv) Problems of renewal of existing underground networks and their development in consequence of the growth of towns.
2. *Techniques of underground works and its new trends*
   - (i) Prefabricated elements for underground works ;
   - (ii) Development of modern tunneling methods. Shield method for traffic tunnels and sewers. Mechanized Shields. Lining of shield driven tunnels. The 'mole' method for cable networks, etc. ;
   - (iii) Modern methods of open cuts. The Icos-Veder method of protection ;
   - (iv) New materials and methods of waterproofing and anti-corrosive coating in underground works ;
   - (v) Anti-sonorous and anti-vibration means in underground works ;
   - (vi) Modern methods of lighting of underground works ;
   - (vii) Ventilation and air-conditioning of underground works ;
   - (viii) Technical problems of urban underground heating networks ;
   - (ix) Underpinning, horizontal shifting of buildings ; and
   - (x) Practice of works, occurred cases, monographic description of executed works.

The above mentioned problems and topics do not include all complicated and many-sided questions of underground works. The participants are invited to suggest or expound other approximate topics. Each such suggestion will be carefully considered by the organizers and if possible included in the programme of the conference. The papers should be submitted in triplicate and may be written in one of the following languages : English, French, Polish or Russian.

Further details can be obtained from the Organizing Committee of the Conference, Polish Committee of Geotechnique and Underground Works, ul. Czackiego 3/5, Warsaw, Poland.

BOOK ACKNOWLEDGMENTS

1. Indeterminate Structural Analysis. J. S. Kinney. *Oxford Book and Stationery Co.*, Calcutta, Rs. 15, 1962, 655 pages.

This world student series edition of the book is a complete and unabridged photo-offset reprint of the original American edition and has been published with the assistance of the Joint Indian American Standard Works Programme. This book is designed to provide an extended introduction to indeterminate structural analysis and is for use as a text-book by degree students and as a reference by the practising structural engineer and architect. A thorough familiarity with determinate structural analysis, and no previous knowledge of indeterminate structures, are assumed. A brief history of evolution of structural theory, included in the first chapter, helps in developing a broad perspective. The next three chapters develop the theoretical foundation of the indeterminate structure analysis. Chapters 5 through 13 include rather detailed discussion and demonstrations of those methods which are most frequently used in the analysis of indeterminate structures. In chapter 14, basic principles and methods of direct and indirect structural model analysis are discussed. The material included in this chapter is based on the author's experience in developing the structural model laboratories at the Rensselaer Polytechnic Institute.

2. Elements of Physical Metallurgy. A. G. Guy. *Oxford Book and Stationery Co.*, Calcutta, Rs. 15, 2nd edition, 1962, 528 pages.

This world student series edition of the book is a complete and unabridged photo-offset reprint of the original American edition and has been published with the assistance of the Joint Indian American Standard Works Programme. This is a revised second edition of a book intended for use in courses in physical metallurgy. Since it treats basic principles, it is suitable for engineering and science students as well as for those whose major interest is metallurgy. A general background of the student in chemistry, physics and mathematics, is assumed. An introductory section orients the student in this new field and briefly surveys the historical background that gives significance to the principles discussed in the body of the text. It is followed by four chapters on the structure of metals and alloys. Important applications of these structural features are discussed in later section of the book. Chapters 7 through 10 further develop the concept that metallic structures and properties are related but the emphasis is on properties of metals and alloys. The final section of the book, chapters 11 through 14, treats the important topic of reactions in metals. An unusual feature is the Appendix on the literature of metallurgy. The usefulness of the technical literature is discussed, and then such types as text-books, handbooks, monographs, abstracts, journals, patents and manufacturer's literature are considered in some detail, and the outstanding examples of each are given. By integrating the study of current practical achievements as examples of fundamental principles, the uniting of practice and principles is accomplished.

3. Electronic User Series—vol. 1: Electronic Devices Networks. Edited by E. E. Zepler and S. W. Punnett. *Blackie and Son Ltd.*, 35s. 217 pages.

The invention of the transistor and the variety of semi-conductor devices, the growth of electronic computers, both analog and digital, and the increasing use of electronic apparatus for measurement and for control are examples of the rapid development of electronics, which has caused the penetration of these devices into an ever-widening range of applications. In big business, in banking and accountancy, in medicine and manufacturing, in textile and chemical industries, the use of electronics has become common place. In science, electronics has revolutionized research technique from radio astronomy to the electron microscope. One result is a demand for knowledge by the user of this bewildering array of electronic apparatus now available.

The technique user series is designed to meet this demand and is intended for qualified scientists and engineers for whom electronics is a fringe activity. It is a series in which later volumes depend to some extent on the earlier volumes. In the first volume, the fundamental principles of active and passive components are mostly treated. The first two chapters deal with electron theory and circuit analysis. These are followed by four chapters on the active elements of electronic circuits, namely valves and semi-conductor devices. There follows a chapter on noise. The book ends with one dealing briefly with the main essentials of a piece of electronic equipment namely a transducer, coupling units and a recorder.

4. Electronic User Series—vol. 2: Electronic Circuit Techniques. Edited by E. E. Zepler and S. W. Punnett. *Blackie and Son Ltd.*, 35s. 1963, 212 pages.

This is the second volume in the Electronic User Series and a working knowledge of the information contained in the companion volume is an absolute necessity if much advantage is to be gained from this book. The main part of this book is made up of a treatment of a few of the many electronic circuits which can be produced. Each chapter deals with a group of associated circuits desorbing feedback system; audio-frequency and video-frequency amplifiers and oscillators; low-frequency and D.C. amplifiers and oscillators; pulse circuits and waveform generation; modulation and demodulation processes; power supplies, and capabilities and use of test equipment.

5. Electronic User Series—vol. 3: Digital Techniques. D. W. Davies. *Blackie and Son, Ltd.*, 30 s. 158 pages.

This third volume of the series deals with the technique of data collection for a computer. After an introduction to some digital systems, the author outlines the preparation of digital data from the physical world and gives an account of digital circuits and design. Electronic circuits are given special treatment because they are a common requirement in the less elaborate uses of digital techniques. A simple problem in digital application is studied in detail and solution developed as far as the logical design stage.

6. **General College Chemistry.** J. H. Wood and C. W. Keenan. *Oxford Book and Stationery Co.*, Calcutta, Rs. 15. 689 pages.

The authors are convinced that the book adequately serves the student's needs with respect to later specification and helps best to give him the stamp of an educated man when it is patterned as a liberal arts course with the aim of developing fundamental principles in each of the major fields of chemistry. This book, then is written from the point of view that general college chemistry should be a liberal arts course of a type which permits specialization in any field (including chemistry) that the student may choose later. A second objective is concerned with writing a book that can be read and understood by college freshman of average preparation and intelligence. For these reasons, structural chemistry, nuclear chemistry, geochemistry, organic chemistry, and biochemistry are covered perhaps somewhat more than is customary. The amount of subject matter presented in the fields of inorganic and metallurgical chemistry is probably less than in most texts, not because these are less important, but because they are not more important than other fields to the beginning student.

PUBLICATIONS RECEIVED

ACTA IMEKO 1961 : Proceedings of the Second International Measurements Conference, Budapest, June 26 to July 1, 1961, has been received from the Publicity Department, Kultura, Budapest 62, Hungary.

Scientists and technologists in the field of measurement and instruments from 26 countries of four continents, took part in the Second International Measurement Conference, held in Budapest between June 26 to July 1, 1961. The large number of papers on specialized branches of the science and technology of Measurements may be considered as the documents of recent achievements in engineering metrology, instrument production, and research, useful for study to the specialists.

The contents of volume 1 (532 pages) (i) Preface, (ii) closing statement, (iii) the Presidential Council of IMEKO 1961, (iv) International Preparatory Committee, (v) Secretariat of the International Preparatory Committee, (vi) International Organizations represented at IMEKO 1961, (vii) Represented National Organizations, (viii) 11 papers of the Plenary Sessions of the Conference, (ix) 4 papers in Section 210 on 'Metrology and Terminology', (x) 8 papers in Section 211 on 'Calculation and Design of Instruments', (xi) 4 papers in Section 212 on 'Technology and Organization of Instrument Manufacture', and (xii) 3 papers in section 213 on 'General Applications of Electronics in Instrument Engineering'.

Vol. 1 (332 pages) contains 17 papers in Section 214 on 'Border Questions Related to Measurement and Automation'. The recent trend in the development of new measuring methods as well as new measuring apparatus for the purpose of measurement and control, is well represented in the papers contained in this volume.

In vol. 3 (535 pages), there are 29 papers presented in Section 221 on 'Instruments and Methods for Measuring Geometrical and Mechanical Quantities, including Geodetic Measurement'.

Vol. 4 (560 pages) presents : (i) 14 papers presented in Section 223 on 'Instruments and Methods for Measuring Thermal Quantities, and (ii) 17 papers presented in Section 224 on 'Instruments and Methods for Physico-chemical Measurements as photometry, spechoscopy, colorimetry, electro-chemical measurements, gas analysis, etc.

Vols. 5 and 6 (771 pages) contains (i) 18 papers presented in Section 225 on 'Instruments and Methods for Measuring Electrical andl Magnetic Quantities', (ii) 10 papers presented in section 226 on 'Instruments and Methods for Measurement in Radio Engineering', (iii) 12 papers presented in Section 227 on 'Instruments and Methods for Measuring Radioactive Radiation', (iv) author's index, and (v) contents of all the five volumes.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

YOUNG CIVIL ENGINEER, passed Sections A and B of the Associate Membership Examination of the Institution of Engineers (India); having first class diploma in civil engineering from the University of Roorkee; 4½ years experience in construction of buildings, roads, water supply and sanitary installations in buildings; estimating; etc.; age 24 years; seeks suitable change as civil engineer preferably in U.P. or Delhi. (Office ref. E.S. 146)

SENIOR EXECUTIVE in a managerial position with an international foreign engineering firm seeks a suitable appointment in Bombay region with reputed Indian/Foreign firm. Minimum basic salary expected Rs. 2,000/2,500 per month. Qualified engineer, possesses University degree, foreign trained, twenty years experience which includes electrical and mechanical erection and maintenance of plants, project and contract work, and administrative duties, and member of several professional institutions. (Office ref. E.S. 147).

SALE OF QUESTION PAPERS OF THE INSTITUTION EXAMINATIONS

The Institution has appointed Messrs. Naba Mudran (P.), Ltd., 170A Acharya Prafulla Chandra Road, Calcutta-4, as sole agents for the reprinting and selling of question papers of the Studentship and Sections A and B of the Associate Membership Examinations with effect from November 1963. **Students and intending buyers should contact them and remit the cost to them directly.**

The question papers are available at the rates indicated below.

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Question papers of Sections A and B examinations (New Scheme)	
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All remittances should cover postal charges. The postal charges for one set of papers is 35 nP. If the set is desired to be sent by registered post, an additional charge of 55 nP. will have to be paid.

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Vol. 13, No. 6, FEBRUARY 1964

Supplement to the *Journal of the Institution of Engineers* (*India*),
Vol. 14, No. 6, February 1964

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THE INSTITUTION, ITS LOCAL CENTRES AND SUB-CENTRES

Headquarters

8, Gokhale Road, Calcutta 20.
P.O. Box No. 669
Telephone 47-4344 (3 lines) Telegrams ENJOIND(P)

Local Centres

Andhra Pradesh	Khairatabad, Hyderabad-4 (*Telephone 33066*).
Assam	P.W.D. Secretariat (R & B), Shillong.
Bengal	8 Gokhale Road, Calcutta 20 (*Telephone 47-2744*).
Bihar	Huda House, Gandhi Maidan Road, Patna 1 (*Telephone 2639*).
Bombay	Ilaco House, Sir Phirozeshah Mehta Road, Fort, Bombay (*Telephone 26-3430*).
Delhi	Mathura Road, near Hardinge Bridge, New Delhi (*Telephone 272703*).
Gujarat	C/o Gujarat Institute of Civil Engineers and Architects Building, Law College Road, Ahmedabad 6.
Jammu & Kashmir	C/o Superintending Engineer, Flood Control Circle, Srinagar.
Kerala	12/33B Observatory Hill, Trivandrum (*Telephone 2563*).
Madhya Pradesh	C/o Government Engineering College, Jabalpur.
Madras	Adam's Road, Chepauk, P.O. Triplicane, Madras 5 (*Telephone 85379*).
Mysore	3 Vidhana Veedhi, Bangalore 1 (*Telephone 25471*).
Nagpur	North Ambazari Road, Nagpur 1 (*Telephone 5671*).
Orissa	3A Cantonment, Cuttack 1.
Poona	Saraswati Sadan, 1287 Shivajinagar, Rani Laxmi Chowk, Poona 5 (*Telephone 7377*).
Punjab	Thapar Institute of Engineering and Technology Building, Patiala.
Rajasthan	C 46, C-Scheme, Jaipur (*Telephone 3327*).
Uttar Pradesh	River Bank Colony, Lucknow (*Telephone 5325*).

Sub-Centres

Baroda	C/o Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Kala Bhavan, Baroda (*Telephone 2629*)
Bhilai	Welfare Building 2, Bhilai Steel Works, Bhilai.
Bhopal	C/o Shri D Dhar, Transformer Engineering Department Heavy Electricals (India) Ltd., Bhopal.
Dhanbad	C/o Executive Engineer, P.W.D., Dhanbad
Durgapur	C/o Chief Electrical Engineer, Durgapur Steel Project, Durgapur.
Jammu	C/o Office of the Superintending Engineer, Electric Project and Planning Circle, Jammu
Jamshedpur	C/o Technical Institute, N Road, Jamshedpur.
Kharagpur	C/o Department of Mechanical Engineering, Indian Institute of Technology Kharagpur.
Nagarjunasagar	Hill Colony, P.O. Vijayapuri North, Nalgonda District.
Neyveli	Central Technical Office, Neyveli 1.
Ranchi	C/o Shri G. S. Prasad, Superintending Engineer, P.W.D., Ranchi Circle, Ranchi.
Roorkee	C/o University of Roorkee, Roorkee.

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

NOTICE OF MEETING OF CORPORATE MEMBERS UNDER BYE-LAW 82(b)(i)

Dated March 27, 1964

NOTICE is hereby given that a Special General Meeting of Corporate Members of the Institution will be held at the building of the Mysore Centre of the Institution, Vidhana Veedhi, Bangalore, on Saturday, 23rd May, 1964, at 9.30 a.m. for the following purpose :

To consider revisions to the Regulations of the Council which have been proposed by the Council of the Institution, and which have been recommended by the Council to the Corporate Members of the Institution at their 434th Meeting held in Hyderabad on 11th February, 1964, as follows :

1. Proposed that the existing Regulations of the Council be amended as shown in the Schedule annexed to the Notice of the Meeting.

By order of the Council
B. Seshadri
Secretary

N.B.—If you are unable to attend the Meeting personally, please fill up the accompanying Form of Proxy with the name of some person whom you think fit to appoint as your Proxy. Please sign the Proxy Form on a revenue stamp of twenty nP. and return the Form to the Secretary, The Institution of Engineers (India), 8 Gokhale Road, Calcutta 20, on or before 20th May, 1964.

Please see Form of Proxy at the end of the Regulations.

REGULATIONS OF THE COUNCIL

Local Centres

Boundaries

1. No Local Centre shall extend its activities outside its specified boundaries without the previous consent in writing of the Council, which consent may only be granted after due notice has been given to the existing Local Centre or Centres concerned and after full consideration of any representations on the subject made by such Local Centre or Centres.

Each Local Centre, as far as possible, shall have in its jurisdiction areas defined by State and States of the Indian Republic.

Obligatory Membership

2. Every Member, Associate Member, Companion, Graduate, Student, Subscriber and Affiliate Member of the Insitution shall, save by special exemption by the Council at its discretion on sufficient reason being shown, belong to the Local Centre within the boundaries whereof he resides or practises or carries on business, provided that he shall not be a member of more than one Local Centre at a time.

Temporary absence for a period not exceeding three months shall be exempted form the operation of this Regulation.

Government

3. Proceedings and affairs of each Local Centre and the property and moneys thereof (including moneys derived from the funds of the Institution) shall be conducted and administered by a Committee consisting of the Chairman, three immediate Past-Chairmen, and not less than six nor more than eleven Corporate Members of the Institution (the actual number to be determined at a General Meeting of the Local Centre) and shall be presided over by a Chairman who shall be a Member of the Institution. Provided that the Council may, when deemed expedient, increase the number of members of any such Committee temporarily. Provided also that the Committee may co-opt additional persons as members of the Committee for special purposes who shall have no vote in the Committee outside the special purpose for which they are co-opted and shall vacate their seats as soon as the special matter shall have been dealt with.

General Conduct

4. The affairs of every Local Centre shall be conducted in accordance with the provisions of the Charter and of the Bye-laws.

Subject to this rule and subject to the approval of the Council, each Local Centre shall have the power to frame rules for the conduct of its own business. Such rules when framed shall be submitted to the Council for approval and shall after approval be valid until the approval of the Council has been given to their repeal or alteration.

REGULATIONS OF THE COUNCIL

of

The Institution of Engineers (India) made pursuant to Bye-law 72

LOCAL CENTRES

1. No Local Centre shall extend its activities beyond its geographical boundaries without the previous sanction of the Council, which sanction shall be only given after due notification to the Local Centre or Centres affected by such proposed extension of activities and after full consideration of any representations on the subject by such Local Centre or Centres.

2. Every class of member of the Institution, save only the Honorary Members and the Honorary Life Members, shall be automatically attached to the Local Centre within the geographical boundaries of which he resides or is in employment or practises or carries on business. The Council shall, however, have the discretion to exempt any member from this provision if he shows sufficient reason why he should be attached to a Local Centre other than the one to which he would be attached by its operation. A member so exempted shall not however hold any office in the Institution as representative of the Local Centre to which he is thus permitted to be attached.

Temporary absence for a period not exceeding six months shall be exempted from the operation of this Regulation.

Members residing or in employment or practising or carrying on business abroad or in Indian territory not within the geographical boundaries of any Local Centre shall be attached to the Headquarters.

3. The affairs of each Local Centre shall be conducted and the property and moneys thereof shall be administered by a Committee consisting of the Chairman and the Honorary Secretary of the Local Centre, two immediate Past-Chairmen, the Chairmen of any Sub-Centres within the boundary of the Local Centre, and twelve Corporate Members. Members of the Council attached to the Local Centre shall be ex-officio members of the Committee.

All the branches of engineering in which the Institution has established Divisions shall be represented in the persons of the twelve Corporate Members specified above such that two Corporate Members are elected from each of those Divisions to which are attached 100 or more Corporate Members, one Corporate Member is elected from each of those Divisions to which are attached less than 100 Corporate Members, and the balance number are elected by all the Corporate Members attached to the Local Centre. In the case where there are no Corporate Members in a particular Division at a Local Centre, the seat appropriate to that Division shall be kept vacant.

The Committee of the Local Centre may, however, co-opt additional Corporate Members for special purposes, but these persons shall have no vote in the Committee outside the special purpose for which they are co-opted and shall vacate their seats as soon as the special matters shall have been dealt with.

Election of Committee

5. (a) The Annual General Meeting of every Local Centre shall be held in November or December each year. At least two months before the Annual General Meeting of the Local Centre, the Honorary Secretary of the Local Centre shall issue a notice to all Corporate Members of his Centre entitled to vote, calling upon each individually to submit the names of Corporate Members with their written consent whom he recommends as suitable persons for election as members of the Committee. Members of the retiring Committee shall be eligible for re-election. Voting papers shall thereafter be prepared showing the names of Corporate Members willing to serve and posted to all Corporate Members of the Centre entitled to vote. The voting papers shall be returnable within 21 days. In the meantime, the Managing Committee of the Local Centre shall appoint not less than three scrutineers from amongst Corporate Members of the Centre. After the expiration of 21 days from the posting, the Honorary Secretary of the Local Centre shall transmit the voting papers unopened to the scrutineers who shall report to the Honorary Secretary the result of the voting. In the event of a tie, the decision shall be made by toss of coin. The report of the scrutineers shall be signed by all the scrutineers present. The Honorary Secretary shall then submit the scrutineers' report to the Chairman of the Annual General Meeting for announcement, and thereafter the voting papers shall be destroyed.

Election of Chairman

(b) Before every Annual General Meeting the Committee of the Local Centre about to retire shall elect one of its members who shall be a Member of the Institution to be the Chairman for the ensuing year and he shall take office at the Annual General Meeting.

The new Chairman shall take office as a Vice-President of the Institution at the next Annual General Meeting of the Institution.

Election for Casual Vacancies

(c) The Local Centre shall immediately inform the Secretary the names of the Chairman and members of the new Committee. Vacancies in the Committee occurring during the year shall be filled up by the rest of the Committee.

Election of Honorary Secretary

6. At the first meeting of the newly elected Committee an Honorary Secretary for the Local Centre shall be elected from the members of the Committee for the current year and shall hold office until the next Honorary Secretary is elected and installed. He shall carry on all correspondence and the general business of the Local Centre, sign all cheques and make all disbursements in accordance with the provisions of the Budget subject to the control of the Committee, and shall cause all accounts to be entered into a book which shall be kept balanced up-to-date and shall be submitted to the Committee at each meeting for examination and approval. He shall also be in charge of the Library of the Local Centre and be responsible for the care and maintenance of the Institution property in the custody of the Local Centre, including buildings.

4. The quorum for a meeting of the Committee of a Local Centre shall be five.

5. The duties of the Committee of each Local Centre shall be to promote the general advancement of engineering science within its boundaries. The affairs of each Local Centre shall be conducted in accordance with the provisions of the Charter, the Bye-laws, and the Resolutions of General Meetings of Corporate Members which have been duly summoned and held in accordance with the Charter and the Bye-laws and duly recorded in the minutes of the meetings.

Subject to the above and subject to the authority of the Council, each Local Centre shall have the power to frame rules for the conduct of its own affairs. Such rules shall however receive the previous approval of the Council.

6. The Annual General Meeting of each Local Centre shall be held in November or December each year. But if this is not found possible due to unavoidable reasons, the prior permission of the Council shall be taken for any postponement. Fifteen days notice shall be given for the Meeting, and this period shall be exclusive of the day on which notice is deemed to be given but be inclusive of the day for which the notice is given. The Audited Accounts of the Local Centre and the Annual Report of the Committee for the preceding year shall accompany the notice. Only Corporate Members shall be entitled to attend. The Committee for the preceding session shall retire at the Annual General Meeting. The business of the Annual General Meeting shall be to receive the Audited Accounts and the Annual Report and the report on the elections to the Committee, and appoint Auditors and fix their remuneration.

7. (a) At least two months before the Annual General Meeting of each Local Centre, but not later than the 31st day of October, the Committee of the Local Centre shall appoint a Board of Scrutineers not less than five in number.

(b) The Board of Scrutineers shall issue a notice to all Corporate Members of the Local Centre, calling upon each of them to propose within 15 days the names of Corporate Members, with their written consent, the Corporate Member considers as suitable persons for election as members of the Committee of the Local Centre. While so notifying, the Board of Scrutineers shall draw the attention of the Corporate Members to the number of seats allotted, in accordance with Regulation 3, to each branch of engineering in which the Institution has established a Division, and invite them to submit names for election taking this into account. Members of the retiring Committee shall be eligible for re-election, and this shall also be stated by the Board of Scrutineers while notifying the Corporate Members as above.

(c) The Board of Scrutineers shall thereafter circulate the names of those Corporate Members who have signified their consent to stand for election to each of them individually, and ask him to inform them within 10 days of the date of posting the letter in case he wishes to withdraw from the election.

(d) The Board of Scrutineers shall then prepare voting papers showing the names of Corporate Members willing to serve on the Committee if elected, and post them to the Corporate Members at their recorded addresses. Voting papers shall be returnable to the Board of Scrutineers within 21 days of the date of posting them.

He shall also be responsible for conducting examinations of the Institution at the Local Centre. He shall work under the general guidance of the Chairman of the Local Centre.

The Local Committee may, if necessary, appoint a Joint Honorary Secretary who if not an elected member of the Local Committee, may take part in the proceedings of the Committee meetings but shall not have the right of voting.

Representation in the Institution

7. Each Local Centre shall elect from its Corporate Membership such number of Members of Council as are allotted to that Centre under Bye-law 26 and to the strength of the membership of the Local Centre relatively to that of the Institution as a whole. This election shall be carried out by such Corporate Members of the Institution as belong to the Local Centre. Such election shall be held in accordance with the Bye-laws and by such a date as shall permit the Committee of the Local Centre to inform the Council of the names of the elected Members and Associate Members by the first day of November in each year and it shall be incumbent on the Committee so to inform the Council. The Members and Associate Members so elected shall take office in accordance with the Bye-laws on the date of the Annual General Meeting of the Institution next following their election. A Member or Associate Member leaving for a period exceeding one year the jurisdiction of the Local Centre by which he was elected shall cease to be a Member of the Council.

Election to the Council

8. The Honorary Secretary of a Local Centre on receipt of a notification from the Secretary that the Local Centre is called upon to hold an election to fill the vacancies other than casual vacancies under Bye-law 31 on the Council caused by retirements under Bye-law 27 or otherwise, shall issue a notice to all members of the Local Centre entitled to vote under Regulation 7, calling upon each individually to submit within 21 days the names of Members and Associate Members of the Institution whom each recommends as suitable persons for election with the nominees' consent duly obtained in the nomination paper. Voting papers shall thereafter be prepared and posted to all members of the Local Centre entitled to vote. The voting paper shall be returnable within 21 days. At the meeting of the Committee of the Local Centre not less than three scrutineers shall be appointed, who shall be members of the Committee of the Local Centre. The Honorary Secretary of the Local Centre after the expiration of 21 days from the date of posting thereof, shall hand the voting papers received up to that date to the scrutineers who shall report to the Committee of the Local Centre the result of voting. The report of the scrutineers shall be signed by all the scrutineers present. In the event of a tie the scrutineers shall decide by toss of coin. Thereafter the Honorary Secretary of the Local Centre shall communicate to the Secretary the result of the election. Such report shall be despatched in time to reach the Secretary before the first day of November in each year. The relative voting papers will be retained by the Local Centre until the following Annual General Meeting of the Institution and thereafter be destroyed.

(e) Any such notice served or sent by post shall be deemed to have been served or delivered at the expiration of ninety-six hours after it was posted.

(f) The Board of Scrutineers shall number and date the unopened envelopes containing the voting papers as they are received by them, and shall lodge them in a ballot box provided for the purpose. The ballot box shall not be removed from the office of the Local Centre under any plea whatsoever, and shall be in the personal custody of the Board of Scrutineers.

(g) The Board of Scrutineers shall, immediately after the expiry of 21 days from the date of posting the voting papers seal the ballot box and arrange to scrutinize the voting papers, prepare their report on the results of the voting, have it signed by all the scrutineers, and present it to the Chairman of the Local Centre. In the event of two members securing equal numbers of votes, the Board of Scrutineers shall decide by toss of coin, and in the event of more than two members securing equal numbers of votes, the Board of Scrutineers shall decide by drawing lots.

(h) The Chairman of the Local Centre shall announce the results of the voting at the Annual General Meeting of the Local Centre. Thereafter, the voting papers shall be sealed and kept by him for 30 days, whereafter they shall be destroyed.

8. Before every Annual General Meeting, the retiring Committee of each Local Centre shall elect one of their members who shall be a Member to be Chairman for the ensuing session. The person so elected shall take office as Chairman of the Local Centre at the Annual General Meeting of the Local Centre, and as a member of the Council at the next ensuing Annual General Meeting of the Institution. A Chairman of a Local Centre shall be eligible for re-election for a further period of office as Chairman for the session only, but after completion of his periods of office (of one session or two sessions as the case may be) he shall not be eligible for re-election.

9. Before every Annual General Meeting, the retiring Committee shall also elect one of their members to be Honorary Secretary for the ensuing session. The person so elected shall take office as Honorary Secretary of the Local Centre at the Annual General Meeting of the Local Centre. An Honorary Secretary of a Local Centre shall be eligible for re-election for further periods of office not exceeding four sessions in all, but after completion of this period he shall not be eligible for further re-election.

10. As soon as practicable after a new Chairman and the members of the new Committee of a Local Centre are elected, the Honorary Secretary of the Local Centre shall communicate their names to the Secretary.

11. Vacancies occurring in the Committee during any session may be filled up by the Committee by co-option. Such co-opted members of the Council shall not be eligible for election as Chairman of the Local Centre under Regulation 8.

12. The Committee of a Local Centre shall, at their first meeting, appoint one or more Joint Honorary Secretary or Secretaries from the members of the Committee for the performance of duties described in Regulation 3.

13. The Honorary Secretary and the Joint Honorary Secretary or Secretaries of a Local Centre shall carry out all their duties always consistent with the provisions of the

In default of Meeting, Council may Appoint Committee

9. In the event of a Local Centre failing to hold its Annual General Meeting within the months specified in Regulation 5, the Council shall be empowered to appoint persons to constitute a Committee in accordance with Regulation 3, and such appointed Committee shall have the same powers and be subject to the same responsibilities as if they had been duly elected in the ordinary course.

In default of Outgoing Committee, Council may Appoint Chairman

10. If any outgoing Committee of a Local Centre shall fail to elect one of its numbers to be Chairman for the ensuing year pursuant to Regulation 5(b), the Council shall appoint a Member of the Local Centre to be Chairman of the Local Centre for the ensuing year.

Notice of General Meetings

11. The proceedings of General Meetings of Local Centres shall be in accordance with Bye-law 45 so far as it is applicable, and reading in Bye-law 45(a), 'Chairman' for 'President' and 'Member of Committee' for 'Member of Council'.

Duties of Committee

12. The duties of Committees of Local Centres shall be (*inter alia*) to promote and advance within the boundaries or their respective Local Centres the objects set forth in the Charter. Committees shall obtain with due frequency papers on novel or interesting aspects of engineering and allied subjects of sufficient excellence to be read before the Local Centres subject only to the Bye-laws.

Supply of Funds by the Institution

13. From the funds of the Institution arrived from the subscriptions of Members, Associate Members, Companions, Graduates, Students, Affiliate Members and Subscribers of the Institution, the Council shall allot every year to each Local Centre the annual grant, to be paid by instalments on dates to be determined by the Council in consultation with the Committee of the Local Centre concerned. All sums contributed to Local Centres shall be directed solely for the objects of the Institution as laid down in the Charter. The accounts relating thereto shall be open at all reasonable times to inspection by a duly accredited representative of the Council.

Power to Raise Moneys

14. The Institution or Local Centres may raise from all classes of their members, with the permission of the Council, sums by subscription or otherwise as they may require for extending their activities for the better attainment of the objects of the Institution as laid down in the Charter ; provided that no Member, Associate Member, Companion, Graduate, Student, Affiliate Member or Subscriber shall be compelled to subscribe or contribute any sum. Local Centres may accept on behalf of the Institution moneys or goods from any source approved by the Council.

Accounts of Local Centres

15. The Committee of a Local Centre shall cause proper books of accounts to be kept and shall on the 31st day of August in each year close these books and shall forward to the Secretary an Income and Expenditure Account signed as being correct by the

Charter, the Bye-laws, the Resolutions of General Meetings of Corporate Members, and the directions of the Council, and work under the direction of the Committee of the Local Centre and the general guidance of the Chairman. The Honorary Secretary shall be responsible for the conduct of all correspondence and office work of the Local Centre; he shall keep all accounts of the Local Centre and present them to the Committee at regular intervals; he shall forward monthly statements of accounts to the Secretary; he shall sign all cheques and make all disbursements in accordance with the provisions of the budget within the grant sanctioned by the Council for the Local Centre under Regulation 21; he shall maintain a register of all classes of members attached to the Local Centre and their addresses; he shall attend all meetings of the Committee and shall have the business thereat correctly and fully recorded and reported, and shall have copies of the minutes sent to the Secretary; he shall ensure that every application for membership received by his Local Centre from the Secretary shall be processed in accordance with Bye-law 25 as expeditiously as possible and returned to the Secretary within a period not exceeding six months from the date of posting it by the Secretary, and in the event of his failing to do so, the Secretary shall process the application in the manner specified in Bye-law 26 as if the application was received from a candidate resident abroad; he shall be responsible for the conduct of the Institution examinations at the Local Centre; he shall have charge of the library of the Local Centre; he shall have charge of all the properties in the custody of the Local Centre; and he shall generally conduct the ordinary business of the Local Centre, and shall refer to the Chairman in any matters of importance requiring urgent decision.

The Joint Honorary Secretary or Secretaries shall have such duties as may be assigned to them by the Committee.

14. Each Local Centre shall elect from its Corporate Members such number of members of the Council as are allotted to the Centre under Bye-law 44. Such election shall be held by such a date as shall permit the Honorary Secretary of each Local Centre to communicate to the Secretary the names of the elected Corporate Members by the first day of November in each year. These Corporate Members shall take office as members of the Council at the next ensuing Annual General Meeting of the Institution.

A Corporate Member elected to the Council from a Local Centre leaving the geographical boundaries of the Local Centre shall cease to be a member of the Council, as provided in Regulation 2.

15. (a) The Honorary Secretary of each Local Centre, on receipt of a notification from the Secretary under Bye-law 50 calling upon the Local Centre to hold an election to fill vacancies in the Council other than casual, caused by retirements under Bye-law 49 or otherwise, shall arrange for the Committee of the Local Centre to appoint a Board of Scrutineers not less than five in number.

(b) The Board of Scrutineers shall issue a notice to all Corporate Members of the Local Centre, calling upon each of them to propose within 15 days the names of Corporate Members, with their written consent, the Corporate Member considers as suitable persons for election as members of the Council from the Local Centre. Members of the Council whose retirements may be causing the above vacancies shall be eligible for re-election, and this shall be stated by the Board of Scrutineers while notifying the Corporate Members as above.

(c) The Board of Scrutineers shall thereafter circulate the names of those Corporate Members who have signified their consent to stand for election to each of them individually, and ask him to inform them within 10 days of the date of posting the letter in case he wishes to withdraw from the election.

(d) The Board of Scrutineers shall then prepare voting papers showing the names of Corporate Members willing to serve on the Council if elected, and post them to the Corporate Members at their recorded addresses. Voting papers shall be returnable to the Board of Scrutineers within 21 days from the date of posting them.

(e) Any such notice served or sent by post shall be deemed to have been served or delivered at the expiration of ninety-six hours after it was posted.

(f) The Board of Scrutineers shall number and date the unopened envelopes containing the voting papers as they are received by him and shall lodge them in a ballot box provided for the purpose. The ballot box shall not be removed from the office of the Local Centre under any plea whatsoever, and shall be in the personal custody of the Board of Scrutineers.

(g) The Board of Scrutineers shall, immediately after the expiry of 21 days from the date of posting the voting papers, seal the ballot box and arrange to scrutinize the voting papers, prepare their report on the results of the voting, have it signed by all the scrutineers, and present it to the Honorary Secretary of the Local Centre. In the event of two members securing equal numbers of votes, the scrutineers shall decide by toss of coin, and in the event of more than two members securing equal numbers of votes, the scrutineers shall decide by drawing lots.

(h) The Honorary Secretary shall communicate the results of the election to the Secretary not later than the first day of November. The voting papers shall be sealed and kept by the Board of Scrutineers till 30 days after the next ensuing Annual General Meeting of the Institution, whereafter they shall be destroyed.

16. In the event of a Local Centre failing to hold its Annual General Meeting in accordance with Regulation 6, the Council shall appoint Corporate Members from that Local Centre to constitute a Committee in accordance with Regulation 3, and such appointed Committee shall constitute the Committee of that Local Centre for the ensuing session, with the same powers and responsibilities as if they had been duly elected in the ordinary course.

17. In the event of a retiring Committee of a Local Centre failing to elect one of their numbers to be Chairman for the ensuing session under Regulation 8, the Council shall appoint a Member of that Local Centre to be Chairman of the Local Centre for the ensuing session.

18. In the event of a retiring Committee of a Local Centre failing to elect one of their members to be Honorary Secretary for the ensuing session under Regulation 9, the Council shall appoint a member of that Local Centre to be Honorary Secretary of the Local Centre for the ensuing session.

19. In the event of a Local Centre failing to elect members to the Council under Regulation 14, the Council shall nominate members of that Local Centre to the Council for one session.

20. The proceedings of General Meetings of Local Centres shall follow, as far as applicable, the provisions of Bye-laws 90, 91, 92, 93 and 94, reading 'Chairman' for President and 'member of the Committee of the Local Centre' for 'member of the Council'. The Corporate Members present shall be the quorum for the Annual General Meeting, and twenty Corporate Members for all other General Meetings.

21. From the funds of the Institution arrived at from the subscriptions of all classes of members—the Council shall allot each year to each Local Centre an annual grant. The accounts relating to this grant shall be open at all reasonable times to inspection by a duly accredited representative of the Council or by the Secretary or his representative.

22. The Committee of a Local Centre may raise from all classes of members attached to that Local Centre sums by subscriptions or otherwise for the purpose of extending the activities of the Local Centre or for the better attainment of the objects of the Institution as laid down in the Charter, provided such contributions are voluntary.

23. The Committee of a Local Centre may, further, accept movable or immovable property, goods, bequests or moneys from sources other than members, provided those sources have been approved by the Council.

24. The Committee of each Local Centre shall cause proper books of accounts to be kept and shall on the 31st day of August in each year close these books and have the accounts duly audited by an Auditor or Auditors qualified in accordance with Bye-law 60(ii). He shall forward to the Secretary a receipts and payment account duly signed by the Honorary Secretary and the Auditor or Auditors by the 15th day of October in each year.

25. The Honorary Secretary of each Local Centre shall prepare a budget of expenditure for each financial year and present it to the Committee of the Local Centre for approval. Thereafter, he shall forward it to the Secretary so as to reach him not later than the 30th day of June in each year. The annual grant to be paid to the Local Centre shall be determined by the Council in accordance with Regulation 21.

SUB-CENTRES

26. (a) Corporate Members not less than fifty in number residing or employed or practising or carrying on business in any contiguous area within the geographical boundaries of a Local Centre, desiring to converge and meet for pursuing the objects set forth in the Charter, may apply to the Local Centre concerned for recommending to the Council the formation of a Sub-Centre in that area.

(b) The Committee of the Local Centre shall give due consideration to such an application, and recommend it to the Council defining the geographical boundaries of the proposed Sub-Centre.

27. No Sub-Centre shall extend its activities beyond its geographical boundaries.

28. Every class of member, save only the Honorary Members and the Honorary Life Members, whose recorded address is within the geographical boundaries of a Sub-Centre shall be automatically attached to that Sub-Centre, without in any way affecting his attachment to the Local Centre within whose boundaries the Sub-Centre is situated.

29. The affairs of each Sub-Centre shall be conducted and the property and moneys thereof shall be administered by a Committee consisting of the Chairman and the Honorary Secretary of the Sub-Centre and not more than seven Corporate Members attached to the Sub-Centre. The Chairman of the Sub-Centre shall be a Member.

The Chairman and the Honorary Secretary of the Local Centre within whose boundaries the Sub-Centre is situated shall be ex-officio members of the Committee.

The Committee of the Sub-Centre may co-opt additional Corporate Members for special purposes, but these persons shall have no vote in the Committee outside the special purpose for which they are co-opted and shall vacate their seats as soon as the special matters shall have been dealt with.

30. The duties of the Committee of each Sub-Centre shall be to promote the general advancement of engineering science within its boundaries. The affairs of each Sub-Centre shall be conducted in accordance with the provisions of the Charter, the Bye-laws, and the Resolutions of General Meetings of Corporate Members.

Subject to the above and subject to the approval of the Committee of the Local Centre within whose boundaries the Sub-Centre is situated, each Sub-Centre shall have the power to frame rules for the conduct of its own affairs.

31. The Annual General Meeting of each Sub-Centre shall be held in November of December each year. But if this is not found possible due to unavoidable reasons, the prior permission of the Committee of the Local Centre concerned shall be taken for any postponement. Fifteen days notice shall be given for the Meeting, and this period shall be exclusive of the day on which the notice is deemed to be given but be inclusive of the day for which the notice is given. The Audited Accounts and the Annual Report of the Committee for the preceding year shall accompany the notice. Only Corporate Members shall be entitled to attend. The Committee for the preceding year shall retire at the Annual General Meeting. The business of the Annual General Meeting shall be to receive the Audited Accounts and the Annual Report and the report on the elections to the Committee, and appoint Auditors and fix their remuneration.

32. The Committee of the Sub-Centre shall be elected each session at the Annual General Meeting of the Sub-Centre. The retiring Chairman shall invite nominations from the Corporate Members of the Sub-Centre present at the meeting, and the election shall be conducted by a majority show of hands.

33. Before every Annual General Meeting, the retiring Committee of each Sub-Centre shall elect one of its members who shall be a Member to be the Chairman for the ensuing session. The person so elected shall take office as Chairman of the Sub-Centre at the Annual General Meeting of the Sub-Centre. A Chairman of a Sub-Centre shall be eligible for re-election for a further period of office as Chairman

for one session only, but after completion of his periods of office (of one session or two sessions as the case may be) he shall not be eligible for re-election.

34. Before every Annual General Meeting, the retiring Committee shall also elect one of its members to be Honorary Secretary for the ensuing session. The person so elected shall take office at the Annual General Meeting of the Sub-Centre. An Honorary Secretary of a Sub-Centre shall be eligible for re-election for further periods of office not exceeding three sessions in all, but after completion of this period, he shall not be eligible for further re-election.

35. As soon as practicable after a new Chairman and the members of the new Committee of a Sub-Centre are elected, the Honorary Secretary of the Sub-Centre shall communicate their names to the Honorary Secretary of the Local Centre within whose boundaries the Sub-Centre is situated and the Secretary.

36. Vacancies occurring in the Committee during any session may be filled by the Committee by co-option.

37. The Honorary Secretary shall carry out all his duties always consistent with the provisions of the Charter, the Bye-laws, the Resolutions of General Meeting of Corporate Members, and the directions of the Council, and work under the direction of the Committee of the Sub-Centre and the general guidance of the Chairman. The Honorary Secretary shall be responsible for the conduct of all correspondence and office work of the Sub-Centre; he shall keep all accounts of the Sub-Centre and submit them to the Committee at regular intervals; he shall forward monthly statements of accounts to the Honorary Secretary of the Local Centre; he shall sign all cheques and make all disbursements in accordance with the provisions of the budget within the grant sanctioned by the Council for the Sub-Centre under Regulation 42; he shall maintain a register of all classes of members attached to the Sub-Centre and their addresses; he shall attend all meetings of the Committee and shall have the business thereat correctly and fully recorded and reported, and shall have copies of the minutes sent to the Secretary and the Honorary Secretary of the Local Centre concerned; he shall be responsible for the conduct of the Institution examinations at the Sub-Centre; he shall have charge of the library of the Sub-Centre; he shall have charge of all the properties in the custody of the Sub-Centre; and he shall generally conduct the ordinary business of the Sub-Centre, and shall refer to the Chairman in any matters of importance requiring urgent decision.

33. In the event of a Sub-Centre failing to hold its Annual General Meeting in accordance with Regulation 31, the Committee of the Local Centre within whose boundaries the Sub-Centre is situated shall appoint Corporate Members from that Sub-Centre to constitute a Committee in accordance with Regulation 29, and such appointed Committee shall constitute the Committee of that Sub-Centre for the ensuing year, with the same powers and responsibilities as if they had been duly elected in the ordinary course.

39. In the event of a retiring Committee of a Sub-Centre failing to elect one of their members to be Chairman for the ensuing session under Regulation 33, the Committee of the Local Centre within whose boundaries the Sub-Centre is situation shall appoint a Member of that Sub-Centre to be Chairman of the Sub-Centre for the ensuing session.

Rights and Privileges

Initials

16. No person shall adopt or shall describe himself by any abbreviation to indicate the class in the Institution to which he belongs other than that provided for by the the Charter, except that a Graduate of the Institution shall be entitled to the exclusive use after his name of the abbreviated designation 'Grad.I.E.(Ind.)', and that for use in India only the abbreviation '(Ind.)' may be omitted.

Certificate of Membership

17. Every Member and Associate Member shall receive on confirmation of his election a Diploma of Membership signed by the President and sealed in accordance with Regulation 30.

Every Companion, Graduate and Student on election or attachment shall receive a Certificate of his connection with the Institution. Every such Diploma and Certificate shall remain the property of, and shall on demand be returned to, the Institution.

40. In the event of a retiring Committee of a Local Centre failing to elect one of their members to be Honorary Secretary for the ensuing session under Regulation 34, the Committee of the Local Centre within whose boundaries the Sub-Centre is situated shall appoint a member of that Sub-Centre to be Honorary Secretary of the Sub-Centre for the ensuing session.

41. The proceedings of General Meetings of Sub-Centres shall follow, as far as applicable, the provisions of Bye-laws 90, 91, 92, 93 and 94, reading 'Chairman' for President, 'member of the Committee of the Sub-Centre' for 'member of the Council', and ten Corporate Members constituting the quorum.

42. From the funds of the Institution arrived at from the subscriptions of all classes of members, the Council shall allot each year to each Sub-Centre, through the Local Centre within whose boundaries the Sub-Centre is situated, an annual grant. The accounts relating to this grant shall be open at all reasonable times to inspection by a duly accredited representative of the Committee of the Local Centre concerned or of the Council or by the Secretary or his representative.

43. The Committee of each Sub-Centre shall cause proper books of account to be kept and shall on the 31st day of August in each year close these books and have the accounts duly audited by an Auditor or Auditors qualified in accordance with Bye-law 60 (ii). He shall forward to the Honorary Secretary of the Local Centre concerned a receipts and payment account duly signed by the Honorary Secretary and the Auditor or Auditors by the 1st day of October in each year.

44. The Honorary Secretary of each Sub-Centre shall prepare a budget of expenditure for each financial year and submit it to the Committee of the Sub-Centre for approval. Thereafter, he shall forward it to the Honorary Secretary of the Local Centre concerned so as to reach him not later than the 15th day of June in each year. The Honorary Secretary of the Local Centre shall incorporate these proposals in his budget of expenditure for the Local Centre prepared in accordance with Regulation 25.

DIPLOMAS AND CERTIFICATES

45. (a) Every Member and Companion shall on election receive a Diploma of membership appropriate to his class signed by the President, a member of the Council, and the Secretary, and sealed in accordance with Bye-law 104.

(b) Every Associate Member shall on election receive a Diploma of membership signed by the President and the Secretary, and sealed in accordance with Bye-law 104.

(c) Every Affiliate Member, Graduate and Student shall on election receive a Certificate of membership appropriate to his class signed by the Secretary.

46. Every such Diploma or Certificate shall remain the property of, and shall on demand be returned to, the Institution.

47. Every Member, Associate Member, Companion and Graduate is entitled to place after his name the designation of the class in the Institution to which he belongs, stated in accordance with the following abbreviated forms, namely, M.I.E., A.M.I.E., Comp. I.E., Grad.I.E.

Professional Conduct

Professional Conduct

18. Members and Associate Members shall be guided by the rules of professional conduct generally accepted as applying to their respective branches of engineering. The Council shall have power to formulate rules under this Bye-law without prejudice to the powers given to them by Bye-law 25.

Admission Fees and Amount of Subscriptions, Deposit, etc.

Admission Fees and Amount of Subscriptions, Deposit, etc.

19. Members of the Institution (other than Honorary Members and Honorary Life Members) shall pay the annual subscriptions and entrance and transfer fees set out in the following tables :

Annual Subscriptions

Class of Member	Amount
Member	Rs. 65
Associate Member	Rs. 50
Companion	Rs. 50
Affiliate Member	Rs. 30
Graduate	Rs. 30
Student	Rs. 20
Subscriber	Rs. 75

Entrance Fees

Class of Member	Amount
Member	Rs. 50
Associate Member	Rs. 40
Companion	Rs. 40
Affiliate Member	Rs. 30
Graduate	Rs. 20
Student	Rs. 10

Transfer Fees

Class of Member	Amount
Student to Graduate	Rs. 10
Student to Associate Member	Rs. 40
Graduate to Associate Member	Rs. 40
Associate Member to Member	Rs. 50

PROFESSIONAL CONDUCT

48. Corporate Members shall be guided by the Code of Ethics for Corporate Members framed by the Council. The Council shall have the power to revise or modify this code from time to time as they deem fit.

SUBSCRIPTIONS AND OTHER FEES

49. The annual subscriptions, entrance and transfer fees, and life compounding fees payable by the various classes of members shall be as set out in the following tables.

Annual subscriptions

Class of Member	Amount
Member	Rs. 80
Associate Member	Rs. 50
Companion	Rs. 100
Affiliate Member	Rs. 50
Graduate	Rs. 40
Student	Rs. 35
Subscriber	Rs. 250

Entrance fees

Class of Member	Amount
Member	Rs. 75
Associate Member	Rs. 60
Companion	Rs. 60
Affiliate Member	Rs. 45
Graduate	Rs. 30
Student	Rs. 15

Transfer fees

Class of Member	Amount
Student to Graduate	Rs. 15
Student to Associate Member	Rs. 60
Graduate to Associate Member	Rs. 60
Associate Member to Member	Rs. 75

(a) Every candidate for election other than for the grade of Member and Associate Member shall, on forwarding his application form, pay his entrance fee and first annual subscription. Every candidate for election as Member or Associate Member shall, however, on forwarding his application form, pay his entrance fee; he shall further pay his first annual subscription at the time when his election as Member or Associate Member is intimated to him. Subsequent annual subscriptions shall be paid in advance in the beginning of each financial year. Provided also that any person elected during the last two months of the official year shall not be required to pay a further annual subscription for the next following year. A candidate who fails to secure election shall be entitled to the return of his entrance fee and first annual subscription, if paid, but without interest thereon and after deducting Rs. 5 as general office charges.

(b) Every candidate for transfer from one class of membership to another shall, on forwarding his application form, pay his transfer fee and difference in subscription for the current year between the class to which he belongs and the class to which he applies to be transferred. Provided that a candidate transferred to another class of membership during the last two months of the official year shall not be required to pay any difference in subscription, but shall make his first payment of his annual subscription at the appropriate new rate in the beginning of the next official year following his transfer. A candidate who fails to secure transfer shall be entitled to the return of his transfer fee and any difference in subscription paid by him but without interest and deducting Rs. 5 as general office charges. Every class of member shall be liable for the payment of dues until he shall have resigned or is expelled.

Payment of Subscriptions

20. All subscriptions become payable on the 1st day of September in each year in advance to the Institution direct and not to or through a Local Centre, and the first subscription of each Member, Associate Member, Companion, Graduate, Student and Subscriber shall date from the 1st day of September preceding his election or attachment as the case may be, and shall entitle him to all publications of the Institution published on or subsequently to that 1st day of September, provided that if a Member, Associate Member, Companion, Graduate, Student or Subscriber be elected or attached, as the case may be, after the last day of February in any year, he shall only be called upon to pay half-subscription for that year, but it shall only entitle him to publications published on or after the date of confirmation of his election or attachment.

Composition Fees

21. Any Member, Associate Member or Companion whose subscription is not in arrear may compound for future subscriptions by a single payment depending on his age at the time in accordance with the tables.* On transfer from Life Associate Member he may similarly compound by paying the difference between the compounding fee for Member and that for Associate Member; otherwise he shall pay an annual subscription of Rs. 15. The table of composition fees shall be liable to alteration from time to time as deemed advisable by the Council on actuarial advice and without notice, but such alterations shall in no wise affect payments on dates antecedent thereto.

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* See Appendix.

Life compounding fees

Age next birthday	Member Rs.	Associate Member Rs.	Companion Rs.
26		665	
27		660	
28		654	
29		646	
30		639	
31		630	
32		623	
33		614	
34		604	
35		595	
36	934	585	1,169
37	917	573	1,145
38	897	560	1,121
39	876	548	1,095
40	857	535	1,071
41	832	521	1,041
42	809	505	1,011
43	780	489	977
44	753	471	941
45	725	453	907
46	693	433	867
47	657	410	821
48	620	388	775
49	582	364	727
50	540	338	675
51	497	310	619
52	449	281	561
53	399	249	499
54	345	215	431
55 and over	284	179	356

Note :—Members, Associate Members and Companions who have attained the age of 55 years or over and have retired from active duty may compound their future annual subscriptions at the following rate :

Member	.. Rs. 250
Associate Member	.. Rs. 150
Companion	.. Rs. 310

APPENDIX

Table of Composition Fees

Age next birthday	Member Rs.	Associate Member Rs.
26		665
27		660
28		654
29		646
30		639
31		630
32		623
33		614
34		604
35		595
36	934	585
37	917	573
38	897	560
39	876	548
40	857	535
41	832	521
42	809	505
43	780	489
44	753	471
45	725	453
46	693	433
47	657	410
48	620	388
49	582	364
50	540	338
51	497	310
52	449	381
53	399	249
54	345	215
55 and over	284	179

Note—Members and Associate Members who have attained the age of 55 years or over and have retired from active duty may compound their future annual subscriptions at the following rates :

For Members	.. Rs. 250
For Associate Members	.. Rs. 150

50. Every candidate for election as Member, Associate Member, Companion or Affiliate Member shall pay a registration fee of Rs. 10 and every candidate for election as Graduate or Student shall pay a registration fee of Rs. 6 towards general office charges, which shall not be refundable, irrespective of whether the candidate is elected or otherwise. The registration fee shall in all cases accompany the application for membership.

51. All annual subscriptions shall be due on the first day of September in each year for the year then commencing. The acceptance of an annual subscription from a person who has ceased to be a member shall not create any presumption as to membership of the Institution.

52. All annual subscriptions shall be paid to the Institution direct and not to or through a Local Centre or Sub-Centre.

53. Every candidate for election as Corporate Member shall pay entrance fee and first annual subscription as Associate Member. If elected as Member, he shall, on notification by the Secretary of election in accordance with Bye-law 29, pay the Institution the difference between the entrance fees and annual subscriptions as Member and Associate Member forthwith. The date of election shall be the date of approval by the Council. A candidate who fails to secure election shall be entitled to the return of his entrance fee and first annual subscription as Associate Member, without interest thereon and after deducting Rs. 5 as general office charges.

54. Every person elected as Companion, Affiliate Member, Graduate or Student and every applicant attached as Subscriber shall, on notification by the Secretary of election or attachment in accordance with Bye-laws 29 and 30 respectively, pay the Institution the appropriate entrance fees and first annual subscription forthwith. The date of election or attachment shall be the date of approval by the Council, but his name shall be entered on the Roll and he shall be entitled to any of the rights and privileges of the Institution only upon such payment being made. If he fails to pay such fees and subscription within three months of his notification by the Secretary under Bye-laws 29 and 30, his election or attachment shall be liable to cancellation.

55. The first annual subscription of a member in any class elected or attached after the last day of February shall be one-half of the annual subscription appropriate to that class under Regulation 49.

56. Any member in any class whose subscription for the current year shall not have been paid before the first day of November shall be 'in arrears of subscription'. If such arrears are not paid by the last day of February following, he shall not be entitled thereafter to receive publications of the Institution as described in Regulation 67, or upon making such payment at a future date to receive the back publications for the period between the last day of February and the date of his making payment.

57. Every member on transfer to a higher class of membership shall pay, apart from the appropriate transfer fee, the full subscription for the current year appropriate to the class to which he has been transferred, and the subscription he has already paid for that year in his previous class shall be taken as in part payment thereof. If the

Resignation

Resignation

22. Every person elected or attached as a Member, Associate Member, Companion, Graduate, Student or Subscriber shall be liable for the payment of his annual subscription until he shall have signified in writing to the Secretary his desire to resign, having previously paid all arrears including the current year's subscription, or until he has forfeited his right to remain in or be attached to the Institution; provided that a letter of resignation may, with the consent of the Council, be cancelled at the request of the sender within six months of its receipt by the Secretary on payment of all sums for which he would have been liable had his connection with the Institution not been interrupted, and he shall thereupon recover all his former rights and privileges without re-election or re-attachment. As subscriptions are payable in advance on the 1st day of September each year, letters of resignation must be sent so as to reach the Secretary by the 31st day of August, *i.e.*, before the new year begins.

transfer has taken place after the last day of February, he shall, however, be required to pay only the difference between one-half the annual subscription in the higher class and one-half the annual subscription in his previous class in addition to the subscription he has already paid in the previous class.

58. All admission fees comprising entrance fees and transfer fees, and compounding fees shall be invested in accordance with Bye-law 77.

59. Any Member, Associate Member or Companion whose subscription is not in arrear in terms of Regulation 56, may compound his future subscriptions by payment of a single compounding fee depending on his age and in accordance with the table in Regulation 49. If as an Associate Member he has already paid life compounding fees, on transfer to Member, he shall be required to pay if he wishes to pay life compounding fees as Member, the difference only between the life compounding fee as Member and as Associate Member applicable to his age at the time of his transfer. If, however, he does not wish to pay life compounding fees as Member, he shall pay an annual subscription of Rs. 30.

60. The table of compounding fees shall be liable to alteration from time to time as deemed advisable by the Council on acturial advice, and without applying the provision of Bye-law 72 of prior approval by a Special General Meeting of Corporate Members. But such alterations shall not affect payments of life compounding fees already made on dates antecedent thereto.

61. Where the Council in their discretion consider that the advanced age and long period of membership of a Member, Associate or Companion justify their doing so, the Council may maintain his name on the Roll without payment of further subscriptions.

62. In the case of a Member, Associate Member or Companion whose earning capacity has been adversely affected by prolonged ill-health, advanced age, or otherwise, the Council in their discretion may also retain his name on the roll without payment of further subscriptions.

Exclusion

Non-payment of Dues

23. If any Member, Associate Member, Companion, Graduate, Stud Member or Subscriber shall leave his subscription in arrear for two yea fail to pay such arrears within three months after a written notice has him by the Secretary, his name shall be struck off the Register unless the (otherwise decide, and he shall thereupon cease to have any rights as Memb Member, Companion, Graduate, Student, Affiliate Member or Subscri shall nevertheless continue to be liable to pay the arrear of subscription time of his name being struck off the Register. The Diploma or Certific person so excluded shall be returned under Regulation 17 to the Secretary o tion immediately. The Council may, if they find good reason to do so, such conditions as they may seem fit, any person who has been a Member Member and whose name has been removed from the Roll. These ca considered and reported upon to the Council by a Committee appointed by for the purpose.

Publications

Publications Generally

25. The Publications of the Institution shall consist of General an Publications and shall be prepared, printed and published under the o Council as often as may be convenient. One copy of each issue shall be Member, Associate Member, Companion, Honorary Life Member, Honora Graduate, Student and Subscriber whose name appears on the Register of th on the date of publication and whose subscription is not in arrear by m months. Each issue shall include, as General Publications :

(a) Reports of all hitherto unreported General Meetings of the I

(b) A list of newly elected Members, Associate Members, (Honorary Life Members, and/or newly attached Graduates. S Subscribers ;

(c) Alterations in deletions from, and additions to the Bye-laws been effected according to law since the preceding issue ;

(d) Any notice or other matter which the Council may consider it insert concerning the property, proceedings or affairs of the I of its Local Centres or for the better attainment of any of the o Institution ;

(e) Personal or obituary notices regarding any persons connect Institution or of special eminence in engineering; and as Te lications, papers read before the Institution with the discussion whole or in part or in a condensed form and with or witho illustrations and tabular matter, as hereinafter more particularl and such other matters as the Council may deem advisable.

PUBLICATIONS

63. The regular publications of the Institution shall be the *Journal*, the *Bulletin* and the *Year-Book*. The Secretary shall be the Editor of these publications, and they shall be prepared, printed and published under the order of the Council.

64. The *Journal* shall be issued in Parts corresponding to the Divisions and the frequency of issue of each Part shall be determined by the Council.

65. The *Bulletin* shall be issued every month.

66. The *Year-Book* shall be an annual publication and shall be published as soon as practicable after the last day of August in each year.

67. Each Member, Associate Member, and Graduate shall on application to the Secretary in writing receive the Part of the *Journal* pertaining to the Division to which he is attached. Further, each Member, Associate Member and Graduate shall also receive individual issues of Parts of the *Journal* pertaining to the other Divisions provided he makes an appropriate application to the Secretary in writing. Each Companion and Affiliate Member may opt for the Part of the *Journal* which he wishes to receive. Subscribers shall receive all Parts of the *Journal*.

Every member of any class shall receive the *Bulletin*. Every member of any class, with the exception of Students, shall receive the *Year-Book*.

PAPERS

68. (a) All papers and articles from members for publication in the *Journal* shall be submitted by authors direct to the Secretary, in accordance with the rules for submission of papers which may be current from time to time.

(b) The Secretary shall obtain from every person submitting a paper or article a statement that it has not been previously published in any form or manner and that he

Institution Papers

26. (1) All papers desired by the authors for publication in the *Journal* shall be submitted to the Secretary. Three copies of the paper shall be provided by the author.

(2) The Secretary shall then forward the paper to the Sectional Chairman concerned.

(3) The Sectional Chairman, acting for the Council, shall decide whether to accept the paper or not, and return it to the Headquarters with his recommendation within a period of two months.

(4) Papers may be independently submitted by the authors to their respective Local Centres. If the Local Centre decides to accept the paper as a Local Centre paper, it shall be read at a General Meeting of the Local Centre, and the Centre may, if necessary, print and circulate the paper.

(5) Papers accepted by the Sectional Chairman shall be printed in the Publications of the Institution together with any report of discussions (after editing by the Secretary) or other matter as the Council may direct, subject to the restriction contained in Regulation 25. All papers published in the *Journal* during any year shall be eligible for prizes.

(6) Each Local Centre shall hold a General Meeting at which the paper shall be read or declared as read and then discussed. The Honorary Secretary of a Local Centre shall notify the Members, Associate Members, Companions, Graduates, Students, Affiliate Members and Subscribers resident within the boundaries of the Local Centre, the place and date of the meeting.

(7) All Members, Associate Members, Companions, Graduates, Students, Affiliate Members and Subscribers attending a meeting shall send their remarks, including confirmation of any remarks made at the meeting in writing to the Honorary Secretary of the Local Centre within 15 days after the holding of the meeting, The Honorary Secretary shall send them to the author for his replies which may also be published along with the remarks.

(8) A Member, Associate Member, Companion, Graduate, Student, Affiliate Member and Subscriber who is unable to attend the meeting may send his comments to the Secretary at any time up to seven days after the date of the meeting on which the paper is read.

(9) The author may, at his discretion, attend any meeting at which his paper is being read or discussed, and may either read the paper himself or lecture upon it, but no author shall be compelled to read his paper or lecture upon it or give verbal replies to discussions and comments unless he wishes to do so.

(10) Papers submitted by non-members shall be dealt with in the aforesaid manner and, if considered suitable, may be published, such papers shall not, however, be eligible for prizes.

will not permit its publication elsewhere before it is accepted or declined by or withdrawn with the consent of the Institution. The paper if accepted for publication by the Institution the copyright therein shall thereupon become the property of the Institution in accordance with Bye-law 101.

(c) The Secretary as Editor of the Journal shall first examine the paper or article, and shall return it to the author if it does not comply with the rules for submission of papers, or if it is of a standard not acceptable to the Institution.

(d) The Secretary shall forward such other papers or articles as he may accept under (c) above to the Chairman of the Division concerned.

(e) The Division Chairman, acting for the Division Board, shall decide whether or not to accept the paper or article, and return it to the Secretary with his recommendations.

(f) If the paper is accepted by the Division Chairman, the Secretary shall arrange for its publication in the Part of the *Journal* concerned as early as practicable.

(g) Papers from non-members may be received by the Secretary and processed in the same manner as described in (a), (b), (c), (d) (e) and (f) above.

(h) Discussions on papers may be submitted by members and non-members to the Secretary within the time specified with the publication of each paper.

(i) Papers may be independently submitted by authors to the Local Centre and Sub-Centres. If accepted, they shall be read at a meeting of the Local Centre or Sub-Centre.

PRIZES

69. All papers and articles written by members and non-members and published in the *Journal* shall be eligible for the award of prizes, except in so far as where the conditions of award of any prize restrict it to a particular branch of engineering or a particular class of membership, when its award shall be made only subject to those conditions.

70. The award of prizes shall be made by the Council, on the recommendations of a Committee consisting of the President, the Division Chairmen, and two other persons to be co-opted by the President if necessary, except where the conditions of award of any prize include the judgment of representatives of the donors, when their recommendations shall also be taken into account.

Communications to the Institution

27. All communications to the Institution, unless declined, shall be the property of the Institution, and shall be published only by the authority of the Council.

Finances

Receipts

24. All moneys received by the Institution shall be paid as soon as possible into the accounts of the Institution with the Institution's Bankers and no part of any receipt shall be withheld from payment into a Bank in order to meet any expenditure.

Miscellaneous

Inspection of Records and Accounts

28. The minutes of all General Meetings of the Institution shall be open to all Members, Associate Members and Honorary Life Members, and those of all Ordinary General Meetings to all Companions and Honorary Members in addition, at all reasonable times on previous notice to the Secretary in writing. The minutes of any meeting of the Council shall be open to the inspection of any Member of Council or Associate Member of Council at all reasonable times. The Accounts of the Institution shall be open to any member of the Finance Committee and of the Council and, on previous notice in writing to the Secretary, to any Member, Associate Member, and (with the previous consent of the Council) to any other person elected or attached to the Institution at all reasonable times.

Access to Property of the Institution

29. All books, drawings, communication, etc., the property of the Institution not being on loan, with the consent of the Council, shall be accessible to Members, Associate Members, Companions, Honorary Life Members, Honorary Members, Graduates, Students, Affiliate Members and Subscribers at all reasonable times. None of the property of the Institution shall be taken out of the premises of the Institution without the consent of the Council.

Common Seal

30. (1) The Council shall provide the Common Seal of the Institution, the custody of which shall be with the Secretary.

(2) The Common Seal shall not be affixed to any instrument except by the authority of a resolution of the Council and in the presence of at least two Members of the Council and of the Secretary or such other person as the Council may appoint for the purpose; and those two Members of Council and the Secretary or other person as aforesaid shall sign every instrument to which the Common Seal is so affixed in their presence.

ACCOUNTS, RECORDS AND PROPERTY

71. All moneys received by the Institution whether at the headquarters, Local Centres or Sub-Centres shall be paid as soon as possible into the accounts of the Institution with the Institution's bankers, and no part of any receipt shall be withheld from such payment into the Bank in order to meet any expenditure.

72. Every Auditor or Auditors of the Headquarters, Local Centre or Sub-Centre shall have the right of access at all times to the books and accounts of the respective offices and shall be entitled to require of the respective offices such information and explanations as he or they may think necessary for the performance of his or their duties. The Auditor or Auditors shall make a report at the time of the annual audit of the respective offices to the members on the accounts examined by him or them and state whether in his or their opinion and according to the explanations given to him or them the said accounts give a true and fair view of the state of affairs of the respective offices.

73. The minutes of all General Meetings of the Institution shall be open to any Corporate Member at all reasonable times on previous notice in writing to the Secretary. They minutes of all meetings of the Council shall be open to any member of the Council at all reasonable times. The accounts of the Institution shall be open to any member of the Finance Committee and of the Council at all reasonable times, and on previous notice in writing to the Secretary, to any Corporate Member. The accounts of a Local Centre or Sub-Centre shall be open, on previous notice in writing to the Secretary, to any Corporate Member attached to that Local Centre or Sub-Centre.

74. The Council shall afford access, subject to such reasonable restrictions as they make think proper, for any Corporate Member to the books containing the minutes of proceedings of any meeting of the Institution. No member shall have any right to inspect any Institution document, other than the books in the libraries of the Local Centres and Sub-Centres, except as conferred by this Regulation or authorised by the Council.

DIVISION BOARDS

75. Each of the Division Boards shall have such powers, duties and functions as may be defined by the Council from time to time. Its activities shall be generally directed to the advancement of the Division as specified in Bye-law 7.

EXAMINATIONS COMMITTEE

76. The Examinations Committee constituted in accordance with Bye-law 34 shall consist of seven Members, one from each Division.

FORM OF PROXY

The Institution of Engineers (India)

I,......................................of.......................... ...
being a Corporate Member of the above Institution hereby appoint.............
....of ....
or failing him..........................of..............................
as my proxy at the Special General Meeting of the Institution to be held on 23rd May, 1964, and at any poll held in connection therewith.

As witness my hand.......................day of...................1964.

20nP

Revenue stamp

Signature...

Name in block letters...............................

Class of membership in—I.E.I........................

ORISSA'S DECADE OF DESTINY 1963-73—A PLAN FOR THE INTEGRATED DEVELOPMENT OF THE RIVER BASINS OF ORISSA*

Dr. A. N. Khosla
Honorary Life Member
Governor of Orissa
Life Member, American Society of Civil Engineers

Summary

This is a Master Plan for the integrated development of the river basins of Orissa.

The Plan reveals the promise and the hope of tomorrow—the 'Destiny of Orissa in the Decade 1963-73'—and the new opportunities for development in Orissa and the adjoining States of the eastern region in the years following.

It is a multi-State Plan, providing complete flood control of the Mahanadi, Brahmani and Baitarani Rivers; irrigation facilities to Orissa, West Bengal and Andhra; inland navigation to the Haldia, Visakhapatnam and Paradeep ports and their hinterlands through a network of irrigation-cum-navigation canals ; and additional power to West Bengal, Bihar, Madhya Pradesh, Andhra, and possibly Uttar Pradesh and Maharashtra.

The overall benefits of the Master Plan and its component units will be :

Benefit	Total Master Plan	River valley projects and hydro power	Thermal power	Core project of Master Plan	Tikerpara power project
Cost, Rs. crores	1,621	825	590	469	175
Flood control					
Mahanadi	Complete	Complete	—	Complete	Complete
Brahmani	Complete	Complete	—	—	—
Baitarani	Complete	Complete	—	—	—
Irrigation, million acres of crops					
Orissa	9.0	5.3	—	4.3	—
West Bengal	1.0	1.0	—	1.0	—
Andhra Pradesh	1.0	1.0	—	1.0	—
Power, million kW					
Hydro (30% load factor)	8.44	7.49	—	4.29	2.0
Thermal	9.0	0.5	8.5	0.25	0.25
Navigation canals and reservoirs, miles	1,230	1,200	—	795	—
Waterspread for fish culture and recreation, million acres ..	1.25	1.0	—	0.65	0.65

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* Text of the Sixth Sir M. Visvesvaraya Lecture delivered at the 43rd Annual Convention, Bangalore, May 19, 1963.

The total Master Plan will cost Rs. 1,621 crores and be completed in the Eighth Plan.

Out of this, Rs. 206 crores have been or will be spent on projects completed or under construction, including installation of 250 MW of thermal power at Talcher.

A sum of Rs. 825 crores (under the head 'River valley projects and hydro power') will be needed to complete all the new river valley projects to provide complete flood control of the Mahanadi, Brahmani, and Baitarani Rivers; irrigation; hydro power and navigation facilities plus the installation of an additional 250 MW of thermal power at Talcher. This part of the Plan will be completed by 1983.

A sum of Rs. 590 crores (under the head 'Thermal power project') will be the cost of generating additional 8,500 MW of thermal power with Talcher coals and middlings at the Bengal-Bihar coal washeries. This part of the Plan will continue into the Eighth Plan, possibly to the year 1991.

A sum of Rs. 469 crores (under the head 'Core project of the Master Plan') of the Rs. 825 crores plan will be needed to complete the core project of the Plan—the Tikerpara-Gania complex. The irrigation part of it will continue in the Fifth or even the Sixth Plan.

A sum of Rs. 175 crores (of the Rs. 469 crores) will be required for the completion of the Tikerpara power project and the Gania Barrage to the minimum essential level with a small part of canal system under way during the period 1963-73—'Orissa's Decade of Destiny'. This part of the Plan will be executed in two stages :

Stage 1 will cost	*Rs. 108 crores, and bring*
gross receipts amounting to	*Rs. 10.2 crores, from which is deducted*
fixed charges equivalent to	*Rs. 6.25 crores, leaving*
a net return of	*Rs. 3.95 crores per year.*
Stage 2 together with	
Stage 1 will cost	*Rs. 175 crores, and bring*
gross receipts amounting to	*Rs. 50 crores, from which is deducted*
fixed charges equivalent to	*Rs. 10.44 crores, leaving*
a net return of	*Rs. 39.56 crores per year*
with the power sold at	*Rs. 250 per kW year.*

This net return of nearly Rs. 40 crores a year will transform the economy of Orissa into a self-generating one, enabling the balance of the Master Plan to be largely executed with the resources generated from the Tikerpara power project.*

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*The figures of cost and return will be somewhat modified as a result of more detailed designs and estimates, and changes in the assumption of sale price per unit or per kW-year of electric power, as also of any additional cost on account of high voltage transmission lines.

'I feel honoured in having been invited to deliver the Sixth Sir Mokshagundam Visvesvaraya Lecture. I accepted this invitation at the insistent persuasion of our President, Maj.-Gen. Harkirat Singh. I am glad I did so despite the apprehension that after assuming charge as Governor of Orissa—which I did on 15th September, 1963, the birthday of Sir M. Visvesvaraya—I would have little time to prepare this Lecture. It was not till the 3rd of May, 1963, that I could get the time to think of the subject of my Lecture and settle down to put it on paper.

The subject of the Lecture posed a problem. I decided to break away from general subjects and write on one which had a direct link with some planning or engineering activity of Sir M. Visvesvaraya and was at the same time of general interest particularly to the State of Orissa. Such a subject I discovered in 'A Plan for the Integrated Development of the River Basins of Orissa', and the first ten years of its implementation as 'Orissa's Decade of Destiny'. Visvesvaraya had been associated during the 1930's with the flood problems of Orissa and had been invited to advise the Government of Orissa in this connection on two occasions, once in 1937 and again in 1939.

Introduction

One of the earliest references dealing with the flood problem of the Mahanadi River—the biggest river of Orissa and which poses the major flood problem—that has come to hand, is a report dated 31st August, 1859, by Capt. John C. Harris (Bengal Engineers), Executive Engineer, Mahanadi Division, in which he recommended:

The demolition of all embankments;

Throwing a dam across the Mahanadi opposite Kundlepur (a short distance above the Mundali weir now under construction);

Taking a diversion canal from above this dam, cutting through the Daltolla ridge, to carry 50,000 cusec. (with opportunity for developing itself to carry 4,00,000 cusec.) and discharging into the Chilka Lake; and also,

Opening of a new mouth to the Chilka Lake for discharging this into the sea.

He estimated the cost of this dam and diversion cut at Rs. 11 lakhs of rupees. For lack of funds, this scheme did not materialize.

In 1858, Sir Arthur Cotton recommended the construction of anicuts across the Mahanadi, Brahmani and Baitarani Rivers, which recommendations were not immediately given effect to on the ground of being 'not productive'. These anicuts were, however, constructed later and, by providing irrigation, reduced the drought problem to some extent. But the flood problem persisted in its old severity.

The Government of Orissa appointed Flood Enquiry Committees in 1927, 1938 and 1940.

The 1927 Flood Enquiry Committee recommended against the construction of reservoirs for the control of floods as being impracticable; and also against the construction of embankments, because of the obstruction they would cause to the flow. They recommended the removal of all embankments in the semi-protected areas.

Visvesvaraya, in his advice of 1937, laid emphasis on investigating the feasibility of constructing flood control reservoirs on any of the three main rivers, but particularly on the Mahanadi. He stated that if a reservoir is constructed, it may be useful in several other ways as well—for extending irrigation, generating electrical power, etc.

The 1938 Committee's Report advocated the policy of flood control through improvement of main rivers by control of discharges and the silt charges; providing better outlets to the sea; adequate strengthening of the embankments; and provision of high level escapes; and recommended that the question of detention or storage reservoirs should be taken up for investigation after other cheaper methods had been tried.

In his advice of 1939, Visvesvaraya expressed satisfaction that flood protection by storage reservoirs in the upper reaches of the rivers had received some consideration, but he appreciated the difficulties regarding construction of these because of State boundaries and the poor financial condition of Orissa Province. He also referred to the proposals made in the past (by Capt. Harris) to make a cut through the Daltolla ridge to divert a portion of the Mahanadi River in times of high flood into the Chilka Lake. He said, 'The proposed cut will be deep and expensive. It might be cheaper to construct a dam provided with undersluices across the Mahanadi at or above Naraj weir and reduce the cutting across the Daltolla ridge. This will probably fulfil two objects; a portion of the floods will be impounded, and the other portion diverted, thereby reducing the discharge of the river through the delta to harmless dimensions'.

The above résumé, besides bringing out the part played by Visvesvaraya in dealing with the flood problem of Orissa, will help in a better understanding of this and other problems of the State.

Orissa and its problems

Orissa mirrors the paradox of all backward areas—poverty amidst potential plenty. Orissa has untold wealth of natural resources—land, forests, water, minerals, a long sea coast; and a population of 17.57 millions. Yet it is the poorest and most backward State of India. Any plan for development of these vast natural resources will help transform poverty into plenty in the State and may well serve as a model for other similarly situated areas in India and elsewhere in the world.

Floods and droughts

For centuries, Orissa has been haunted by the twin spectres of flood and drought, and of these, the latter has been the more terrible. The distribution of rainfall and consequently of the river supplies through the year vary within wide limits. There is too much water during the rains and too little during the dry part of the year, with the result that Orissa continues to suffer devastation by floods and starvation, misery and disease from droughts. Terrible famines occurred in the 14th, 15th and 16th centuries. In the memorable famine of 1770, people were reported to have died in hundreds and thousands. Nearly a century later came the great Orissa famine of 1865-66. The rainfall in 1865 was scanty and ceased prematurely. Foodcrops failed and it was estimated that nearly one million people died in the District of Cuttack alone. In the District of Puri, nearly 40% of the population perished. Then followed the flood of 1866. Crops and property were destroyed and what the drought had spared was engulfed in the wide flood waters.

Only two years ago in 1961, serious flood damage occurred over 3,600 sq. miles of area; 650,000 acres of crops were damaged and 19 human lives lost. The expenditure on relief alone was Rs. 5.77 crores.

Severe drought conditions prevailed in most districts of Orissa in 1962 due to failure of rains. Twenty-five per cent of the total cultivated area of the State was affected. The estimated loss of *kharif* crop was more than Rs. 60 crores.

Flood control and irrigation are the two basic needs of Orissa.

General features

Physical (*vide* Fig. 1)

The State of Orissa is situated in the north-eastern section of the Indian peninsula and extends over an area of 60,136 sq. miles. It is a maritime State with a coastline of 250 miles along the Bay of Bengal. It has a common boundary with West Bengal in the north-east, Bihar in the north, Madhya Pradesh in the west, and Andhra Pradesh in the south-west. It can be divided into four main physical regions—the northern plateau, the central tableland, the Eastern Ghats, and the coastal plain.

Climate

The mean maximum temperature is 91°F. (33°C.), rising to 101°F. in April and May, and falling to 80°F. in January. The mean minimum temperature is 70°F. (21°C.). The average rainfall is 59 in. About 81% of this rainfall is received during the period June-September, mainly from the Bay of Bengal branch of the south-west monsoon.

Population

According to the 1961 Census, the population of Orissa has gone up to 17.57 million, with a density per sq. mile of 292. The increase in the total population during the decade 1951-61 was 1.99% per annum. The coastal District of Cuttack has the heaviest density of population which is over 600 per sq. mile. Adibasis, scheduled castes, and other backward classes constitute nearly 67% of the State's population, the Adibasi population accounting for nearly 24%.

Living standards

The per capita income of Orissa during 1960-61 was Rs. 212, as against the all-India average of Rs. 330.

Natural resources

The most important of Orissa's natural resources are its land, forests, water, mineral and marine wealth.

Land and agriculture

The total area of the State is about 38.4 million acres, of which about 36% was cultivated in 1955-56. Orissa's main weakness stems from its poor agricultural base, archaic cultivation, vagaries of the monsoon, and damage due to recurring floods, all resulting in low yields and uncertain harvests. The yield of rice, which is Orissa's chief crop, accounting for over 63% of the total cropped area, is the lowest in India—514 lb. per acre as compared with 1,255 lb. in Madras and 806 lb. for India as a whole. This can easily be doubled or more if adequate irrigation and modern facilities can be assured.

Eight out of every ten Oriyas subsist on agriculture.

Forests

Next to Madhya Pradesh, Orissa has the largest forest area amongst the States of the Indian Union, covering 25,331 sq. miles, or nearly 41.01% of the total land area. Apart from their effect on climate and their role in preventing soil erosion, the forests provide valuable raw materials for industry and are an important source of revenue to the State.

Water

Orissa has enormous water wealth in its many rivers which are fairly evenly scattered over the State. Between them they carry a mean annual flow of nearly 121 million acre-ft., or, roughly one-tenth of the total runoff of the entire river system of India. The runoff is, however, very unevenly distributed through the months. There is either too much water during the monsoon period resulting in heavy floods, or too little during the dry season, resulting in failure of crops.

Minerals (*vide* Fig. 2)

Orissa has enormous mineral wealth. The resources so far known are considerable and diverse, and the potential mineral occurrences give promise of discovery of large deposits. Moreover, several occurrences are yet to be explored and about one-third of the State remains to be surveyed by the Geological Survey of India. Taking all these facts together, Orissa would have perhaps the largest mineral resources among all the mineral-bearing States of India. It has iron ore, manganese ore, coal, dolomite, limestone, chromite, china clay, graphite and fire clay. The present estimate places the iron ore reserves at about 10,000 million tons, and of coal at about 40,000 million tons, both nearly 50% of all-India estimates.

Fisheries

Fisheries, both inland and marine, occupy an important place in Orissa's economy. Nearly 35,000 persons have fishing as their principal means of livelihood in the Chilka Lake (450 sq. miles in area) where nearly 3,500 tons of fish are raised each year. The yield per acre from Chilka Lake is 75 to 100 lb., one of the highest in the world for brackish water fisheries.

Orissa has a 250-mile long coastline which is covered in many parts by river mouths and estuaries. On an average, the State produces a total of 23,000 to 25,000 tons of fish per year, of which about one-third is sea fish and the remainder estuarine and fresh water fish from all the inland sources. Fisheries contributed roughly Rs. 1.76 crores to the State income in 1956-57. Considering that Orissa is a maritime State, the share of fisheries in the State income is low. There are hardly any fish-based industries in the State.

Table 1

Rivers of Orissa

River	Catchment area, sq. miles	Mean annual rainfall, in.	Mean annual runoff in.	Mean annual runoff million acre-ft.	Maximum flood discharge, cusec.	Minimum* dry weather discharge, cusec.
(1) Mahanadi (Naraj)	51,270	57.36	27.51	75.25	1,580,000 2,700,000**	1,500
Brahmani	14,000	58.93	27.45	20.50	800,000	300
Baitarani	4,000	58.93	27.45	5.86	500,000	100
	69,270			101.61		
(2) Rushikulya	3,072	43.50	8.47	1.43	300,000	Nil
Burabalanga	1,736	56.28	22.55	2.09	200,000	50
Subarnarekha	7,047	56.28	22.55	8.46	600,000	100
	11,855			11.98		
(3) Indravati†	1,040	74.00	40.09	2.27	240,000	100
Koleb (Sabari)	1,200	70.00	33.02	2.12	260,000	120
Sileru†	1,855	70.00	38.02	3.28	323,000	190
	4,095			7.67		
Total	85,220			121.26		

* Figures of minimum dry weather discharge are for the natural flow of the rivers before any storage dam is constructed on any of them.

** Accepted for design.

† Above the lowest dam sites in Orissa territory (Indravati, Koleb and Sileru are tributaries of the Godavari River).

Coastal fishing is confined to a narrow belt of 3 or 4 miles over a relatively short stretch of the coast. On account of lack of proper berthing, landing and other harbour facilities, no offshore fishing has developed in the State. It would be possible and profitable to use a large number of bigger boats and operate trawlers if proper berthing and harbour facilities were developed at suitable locations along the coast. There are rich fishing grounds in the sea off the coast of Orissa.

Industries

Orissa, one of the richest States in India in land, forests, minerals, water and marine resources, has remained industrially backward because of the lack of cheap electrical power and adequate transport and communication facilities. The total power installed in the state was 300 kW in 1945.

One sugar mill, a glass factory, a soap works, a few oil mills, and a number of rice mills comprised the entire industry of Orissa in 1945.

The First and Second Five Year Plans have, however, provided a much-needed impetus to the industrial development of the State with power becoming available from the Hirakud and the Machkund hydro-electric projects. The Rourkela steel plant, with an annual production capacity of one million tons of ingot steel, was put up during the Second Five Year Plan. A fertilizer factory, with an annual capacity of 50,000 tons of nitro-limestone, has been set up in the immediate neighbourhood of the steel plant to utilize the by-products of the steel works as raw materials. Ferromanganese plants have been set up at Joda and Rayagada. An aluminium smelter, with an annual capacity of 20,000 tons, has been set up near the Hirakud power station. Orissa has two large cotton mills near Cuttack, three sugar factories at Aska, Rayagada and Singhpur Road, with three more coming up; and three paper mills, at Brajarajnagar in Sambalpur District, at Chaudwar in Cuttack District, and near Rayagada in Koraput District.

Transport and communications

Inadequate transport and communication facilities have been a major barrier to the economic and industrial development of Orissa. As against an all-India average of 31 miles of rail track for every 1,000 sq. miles of territory, the State has only 14 miles. Similarly, for every 1,000 sq. miles, Orissa has 53 miles of surfaced roads compared to 261 miles for Madras, 124 miles for Andhra, and 102 miles for West Bengal.

Ports

Despite an extensive coastline, Orissa will be having by the end of the Third Five Year Plan one port—the Paradeep port—only recently taken up for construction, which will be ready by the end of 1965 and will handle 2 million tons of iron ore by 1965 and may be extended later to handle 10 to 15 million tons per year.

Inland navigation

Orissa has a network of small navigable canals—Taldanda, Kendrapara, High Level, Coastal and Jajpur canals, totalling 154 miles in length, which provide the cheapest means of transport in the coastal areas of Orissa. These have been somewhat improved after the completion of the Hirakud Dam project and the Delta Irrigation Scheme.

Planning for prosperity

From many points of view, Orissa, potentially the richest, is probably the most backward region in the country. The poorer the region the more urgent is the need for accelerating growth, but the greater also is the difficulty in raising internal resources for investment. This is Orissa's dilemma.

Given these resources and the will to achieve, Orissa is destined to be the most industrially advanced State in India.

The plan provisions during the First, Second and Third Five Year Plans and the expenditure during the First and Second Plans are given below.

Orissa has 4.02% population and 4.96% area of the all-India figures. It has 10% water wealth and almost 40 to 50% mineral wealth of the total water and mineral wealth of India.

Table 2

Plan outlays and expenditure (crores of rupees)

All-India plan				Orissa plan					
Plan	Outlay	Total of State plans	Central assistance to States	Outlay	Expenditure	State resources	Central assistance	Percentage of total of State plans, col. 5 / col. 3	Percentage of total Central assistance, col. 8 / col. 4
1	2	3	4	5	6	7	8	9	10
First Plan (1951-56)	1,960	898	350	74.5*	68.1*	8.0	60.1	8.3	17.2
Second Plan (1956-61)	4,600	2,043	1,038	100.0*	84.0*	18.3	65.7	4.9	6.3
Third Plan (1961-66)	7.500	4,020	2,375	160.0* 220.0	104.0 (a) 227.0 (b)	31.3	128.7†	3.98 5.6	5.4

* Includes outlay and expenditure on Hirakud, but excludes all Centrally sponsored schemes.

(a) Expenditure of first three years including current year's anticipated outlay.

(b) Anticipated total to the end of Third Plan.

† On the basis of the overall Central assistance of Rs. 2,375 crores available for all States.

Any plan for the overall development of this extremely poor but potentially richest State in India must give first consideration to the solution of the problems of flood and drought. Conservation of flood waters during the monsoon through storage and their utilization through regulated releases during the dry parts of the year for purposes of flood control, irrigation, power generation, navigation, fish culture, tourism and other facilities must, therefore, constitute the core of the plan. This coupled with the accelerated pace of development of industries based on the immense water resources and mineral wealth of the State and consequent on large scale increase in agriculture, power and transport facilities under the plan, will need proportionately much greater outlay in the Fourth and subsequent Plans than has been provided for Orissa in the Third and earlier Plans.

The May 1945 Plan

The plan for the unified development of the Mahanadi basin as a first step in the overall integrated development of the river basins of Orissa, was conceived by me a Chairman of the Central Waterways, Irrigation and Navigation Commission (Central Water & Power Commission) in May 1945. This plan envisaged the construction of three storage dams on the Mahandi at Hirakud, Tikerpara and Naraj, for securing complete control of the Mahanadi floods, and for developing power, irrigation, navigation, pisciculture and other facilities.

The construction of the Hirakud Dam and power plant was undertaken in 1949-50 immediately after the surveys and investigations were completed and the project report was prepared and approved. This constituted the first stage in the plan of basinwide development of the Mahanadi River. It was completed in 1956 and inaugurated in 1957. The project for the construction of the Naraj Dam was later substituted by that of a diversion weir at Mundali nearby, which is now in progress.

The project for the construction of the Tikerpara Dam, which constitutes the core of the May 1963 Master Plan, is actively under investigation and preparation.

The May 1963 Master Plan

The May 1963 Master Plan for Orissa is a continuation of the May 1945 Plan and has been conceived in the background of the history of droughts in the 14th, 15th, 16th and 18th centuries and the recurring devastating floods, of the more recent flood of 1961 and the drought of 1962 with its estimated loss of crops worth over Rs. 60 crores, and the continuing miserably low standard of living of the people. It is a Plan for the total development of Orissa for agriculture, power, transport, industry and social services through the integrated development of its river basins. The development for power includes hydro power from stream flows as well as thermal power from Talcher coals and from middlings at the coal washeries in Bihar-Bengal coalfields.

The Master Plan will provide all the essential requisites for the development of agriculture, mining and industry, which constitute the base for all economic advance and defence build-up. These requisites are protection from floods; water for irrigation, industry and domestic use; electric power for factory and farm; water and other transport facilities, lakes and reservoirs for pisciculture, recreation, tourism, etc. The present exposition of this Plan deals with these aspects of development only and that in broad terms. The details will have to be filled in after due investigation, by the appropriate departments of the State or States concerned.

The development of the various industrial complexes made possible by the above developments will be dealt with separately.

The Master Plan can be considered in two parts:

Part 1—River Valley Projects: dealing with all developments pertaining to water, which includes flood control, irrigation, hydro-electric power, inland waterways for navigation, fish culture, tourism, and a possible seaport and harbour at Chilka Lake.

Part 2—Thermal Power Projects: based on Talcher coals or, alternatively, also on middlings from washeries in the Bihar-Bengal region, the phasing of thermal power development in step with the stages of development of the river valley projects, and the economics thereof.

The salient features of part 1 projects are summarized in Table 3 and those of part 2 projects in Table 4.

For part 1—River Valley Projects, the programme of development is envisaged under six groups—A, B, C, D, E, and F.

For Part 2—Thermal Power Projects, the programme of development for optimum results is tentatively phased in Table 4 to correspond to and dovetail into the programme of development under groups A, B, C, D and E of River Valley Projects. This assumes that the necessary resources will become avalable at each stage. This phasing can be altered to suit availability of funds and regional power needs.

Priorities

The river valley projects have necessarily to be developed first. These, besides power, provide, firstly, the basic needs of Orissa, namely, flood control, irrigation and fish culture, and incidentally also navigation, tourism, etc.; and, secondly, power at a much lower unit cost than thermal power whether developed with cheap coals at Talcher or with middlings at the washeries (see last columns of Tables 3 and 4).

A multi-State plan

The 1963 Master Plan is not a plan for Orissa only. It is essentially a multi-State plan for the six eastern States of India. In respect of power, it is a plan for the eastern region comprising Orissa, West Bengal, Bihar, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh, and possibly also Maharashtra. In respect of irrigation, it is a plan for Orissa, West Bengal and Andhra.

The pace and pattern of development of power will be determined, besides the needs of Orissa, by the combined needs of the region as a whole, and also by consideration at each stage, of the relative proportions of hydro and thermal power generation to ensure maximum utilization of installed capacity (both hydro and thermal) and minimum unit generation cost.

As regards irrigation, it appears possible to extend irrigation from the Mahanadi water stored at the Tikerpara Dam to a million or more acres of land in Midnapur District in West Bengal, extending from the Orissa border to the Rupnarain River and Haldia port, and to a similar acreage (if physically within limits of command) in Andhra Pradesh extending from the Orissa border to Visakhapatnam port.

Participation of West Bengal and Andhra Pradesh Governments

As to whether West Bengal and Andhra would like to share in the stored waters at Tikerpara for the purpose of irrigation, a decision will have to be taken at an early stage, as that will vitally affect the scope of the project and the design and layout of its channels. Providing irrigation water to agricultural areas in these States and water for domestic and industrial use to the ports of Haldia and Visakhapatnam will need substantial enlargement of the main canals on the two banks and adjustment of their full supply levels to feed these additional supplies.

Haldia and Visakhapatnam ports

There is also the possibility of providing reliable water supply from this source for the port and town of Haldia as also for the port and town of Visakhapatnam, including all future extensions. The latter is under investigation.

Navigation

Regarding navigation, the main irrigation canals will be navigable. These and the various reservoirs will provide about 1,000 miles of navigable waterways traversing through Orissa and, if the Governments of West Bengal and Andhra agree, 80 miles in West Bengal and 150 miles in Andhra, terminating at Haldia port in West Bengal and Visakhapatnam port in Andhra. The Paradeep port under construction, the proposed Santrapur port on Chilka Lake, the proposed Haldia port, and the Visakhapatnam port will form part of this inland waterway system linked to each other through this network of irrigation-*cum*-navigation canals.

Part 1—River Valley Projects

The following are the six groups of river valley projects (*vide* Table 3 and Fig. 3).

Group A—This includes projects which were completed during the Second Plan, *viz.*, the Hirakud Dam project for flood control, irrigation and hydro-electric power (completed 1956), and its extension, the Chiplima power canal and power plant (completed 1963); and the Machkund Dam project for hydro-electric power (completed 1959); and projects approved and taken up for construction, *viz.*, Balimela Dam project for irrigation and generation of 360 MW of hydro-electric power and thermal power generation of 250 MW at Talcher. These between them, will provide irrigation for 2.53 million acres of crops and have an installed capacity of 0.95 million kW at 30% load factor.

Group B—This includes the Tikerpara-Gania project—the core project of the May 1963 Master Plan—and the small Tikra project. These will provide complete control of the Mahanadi floods in the delta, irrigation to nearly 6.3 million acres of new area (*kharif* plus *rabi*), hydro-electric power generation to the tune of 4.29 million kW at 30% load factor, and a network of navigable canals about 750 miles in length, extending from one end of Orissa to the other, and, if Andhra and West Bengal participate, also to Visakhapatnam and Haldia ports. The Tikra Dam project, which will ultimately become a part of the Barkot Dam project under Group D, is essential for water supply to the Talcher thermal station and the coal-based industrial complex to be established between Talcher and Tikerpara. This will later provide the navigation link between Talcher and the Mahanadi River and from there to Paradeep port.

Group C—This includes the Indravati and the Upper Kolab projects in the Districts of Koraput and Kalahandi. These will irrigate 880,000 acres of new areas and will have an installed capacity of 1.16 million kW of hydro-electric power at 30% load factor. Of these, the Indravati project appears to be the most attractive.

Group D—This includes the Barkot Dam project on the Brahmani River—the second key project of the Plan—and the Lower Kolab project in the Kolab tributary of the Sabari river. These between them will irrigate 1,053 million acres and have an installed capacity of 1.42 million kW (at 30% load factor). The Barkot project will, in addition, provide flood control of the Brahmani River and a navigable waterway connecting the Rourkela steel plant and the Bonai iron ore deposits with Talcher coalfield and the Paradeep and the proposed Santrapur ports. It will also provide a navigation link to Tikerpara reservoir through the Barkot-Tikra-Rampur link and further on to Chiplima and to Hirakud reservoir through the Rampur-Deogaon link.

Group E—This includes the Bhimkund project on the Baitarani River. This will provide flood control of the Baitarani River and an installed capacity of 624,000 kW (at 30% load factor). It will also provide a small amount of irrigation, the bulk of the area under command having already been taken care of under the Tikerpara-Gania project. A project report for this has already been prepared, but this project has been kept lowest in order of priority, and can be taken up only if the need for flood control and additional power provide the justification.

Group F—This includes projects on the many tributaries of the rivers of Orissa. Of these, the ones on the Mahanadi appear to possess considerable potential for irrigation and to a smaller extent for power. These projects have not been examined even in a preliminary way. Some of these may be taken up as medium irrigation projects at various stages of development of projects under Groups B, C and D.

Apart from the Tikerpara project, the survey, investigation and preparation of project report relating to which are in an advanced stage, and the Bhimkund project, the report on which has already been prepared, the planning for the other projects is based mainly on available hydrological data, printed topographical maps, site inspections, and limited site investigations. The figures of runoff are a fairly close estimate. The figures of cost are in the nature of the best guess possible under the circumstances, but believed to be fairly representative. Those for Tikerpara power project are firm figures as a result of detailed designs and estimates.

Table 3 gives salient features of each group and of each project in that group.

Part 2—Thermal power projects

The justification for thermal power generation on a large scale arises :

Firstly, because the Talcher coalfields are said to have a reserve of some 40,000 million tons of non-coking coals, the poorer qualities of which can be used for power generation to any extent, and also because it is stated that large quantities of middlings will be thrown up by the washeries in the Bihar-Bengal coalfields, which will become available for the picking for generation of relatively cheap thermal power, and which, if not used for that purpose, will occupy space for disposal and cost money later to remove ; and

Secondly, because hydro power stations unless backed by thermal support in a grid and thermal power stations unless similarly backed by hydro support, will not be able to ensure maximum utilization of the installed capacity of either system, and will, therefore, not achieve maximum economy in generating costs.

As will be seen from the last columns of Tables 3 and 4, the unit cost of generation of hydro power is much less than that of thermal power. It is particularly so in case of the Tikerpara project. For instance, unit costs of hydro generation at Tikerpara and thermal generation at Talcher (which will also be the cost of generation based on middlings at washeries for equal price of coal), as given in Table 4, compare as follows :

Table 5

Costs of generation at Tikerpara (hydro) and Talcher (thermal)

Phase	Hydro at Tikerpara			Thermal at Talcher or washeries	
	Installed capacity, MW	Cost of generation, nP per kWh		Installed capacity, MW	Cost of generation, nP per kWh
		(a)	(b)		(c)
2	1,000	0.945	1.24	1,500	2.32
3	2,000	1.15	1.44	4,000	2.18
4	2,750	1.38	1.66	6,500	2.23
5	2,750	1.38	1.66	9,000	2.13

(a) Based on cost allocation to power (inset, bottom, Table 3)

(b) If entire cost of dam charged to power and nothing to flood control or irrigation.

(c) Based on cost of coal or middlings at Rs. 20 per ton inclusive of transport cost, cesses and taxes, and 1.435 lb. of coal required to generate one kWh. The cost of 1.435 lb. of coal $= \frac{1.435 \times 20 \times 100}{2,240} = 1.28$ nP. Fuel cost per unit, therefore, equals 1.28 nP per kWh.

(If cost of coal or middlings is reduced to Rs. 12 per ton, the fuel cost per unit will be $\frac{1.28 \times 12}{20} = 0.768$ nP.)

From the above, it is obvious that generation of hydro power which is much cheaper than thermal power and has the further advantage that the works constructed for this purpose will also serve the other vital purposes of flood control, irrigation, navigation, fish culture, tourism, etc., must receive first priority, particularly, if funds are limited.

Even where funds are available and stream flows still exist for generation of hydro power, thermal power will be justified only to the extent that it firms up hydro generation and permits maximum use of installed capacity. In cases where stream flows are no more available for generation of hydro power, thermal generation is the only alternative for augmenting power supply to meet rising demand.

Where thermal electric power has to be generated in bulk for other reasons, such as the necessity to use middlings thrown up by the washeries in the Bihar-Bengal coalfields—which will otherwise use space and cost money to remove—the important fact should be recognized that unless hydro power is available in a grid to take the peak loads and otherwise cater to the wide fluctuations in load, the cost of thermal generation will rise unduly highly.

Effort has been made towards striking a rational system balance between hydro and thermal generation (Tables 4 and 6). A system load factor of 65% will obtain in phase 4 and after, and of 70% during phases 1, 2 and 3. This may be summarized as follows.

Table 6

Installed capacity, MW

Phase	Hydro*	Thermal	Total
1	902	500	1,402
2	3,557	1,500	5,057
3	5,721	4,000	9,721
4	7,892	6,500	14,392
5	8,443	9,000	17,443

* Installation at 30% load factor

Table 6 will be valid on the presumption that funds are available for thermal generation in addition to hydro generation and irrigation in accordance with the above proposed phasing. The pattern of actual thermal development, in addition to 500 MW at Talcher which will be installed in any case, will of necessity have to follow the pattern of financial allocations in this respect. Tables 7 and 8 explain this.

Cost and benefits of the May 1963 Master Plan

For purpose of assessment of the economic justification of various components of the Master Plan in relation to availability of resources, the Plan may be divided into the following five component-combinations :

C.C. 1 — Projects completed or under construction as given in Group A of Table 3 plus 250 MW thermal generation at Talcher of Table 4.

C.C. 2 — New river valley projects, which constitute the core of the Master Plan and, therefore, must have the highest priority, given in Group B of Table 3 plus another 250 MW thermal generation at Talcher bringing the total thermal to 500 MW.

C.C. 3 — All new river valley projects included under Groups B, C, D and E.

C.C. 4 — All new river valley projects included under Groups B, C, D and E including the 250 MW thermal plant under C.C. 2 above plus thermal generation of additional 8,500 MW.

C.C. 5 — The total Plan.

The cost and benefits figures of the various components and component-combinations mentioned above are given in Table 7, data having been obtained from Tables 3 and 4.

The total cost of the Master Plan (exclusive of the cost of the industrial complex that will be established as a result of the development of power, irrigation and navigation under the Plan) has been estimated at Rs. 1,621.32 crores.

Of this, Rs. 205.86 crores is accounted for by projects already constructed or under construction, leaving Rs. 1,415.46 crores as the cost of new projects.

Thermal generation at Talcher will not be necessary beyond the 250 MW under installation (C.C.1) and the 250 MW included under C.C.2 (serial 2 of Table 7) until the 7,743 MW of hydro power under C.C.3 (serial 6 of table 7) which are the cheapest to generate, have been used up.

The total cost of projects under C.C.3 (serial 6—all new hydro projects plus 500 MW of thermal power) is estimated at Rs. 825.46 crores. This component-combination of the Master Plan estimated to cost Rs. 825.46 crores is, therefore, the one which needs consideration at this stage. The balance of Rs. 590 crores for thermal generation may be left for consideration at a later date.

For implementation, however, Orissa must proceed forthwith with the core projects of the Plan (C.C.2), namely Group A plus the additional 250 MW of thermal power (serial 2 in Table 7) estimated to cost Rs. 469.31 crores.

The T.V.A. of U.S.A.

It was in 1933 that the U.S. Congress set the Tennessee Valley Authority to the task of developing the resources of the Tennessee valley. The T.V.A. has cost 1.757 billion dollars to the end of 1962, the equivalent of Rs. 842 crores (at Rs. 4.79 to a dollar). It will be 30 years old this year.

The T.V.A. has tamed the once treacherous Tennessee River whose floods used to carry away topsoil, houses and barns.

The waters of these rivers now provide one of the world's finest inland recreation areas and yield some 10 million lb. fish per year.

The main stem dams have navigation locks permitting the passage of vessels with 9 ft. drafts. Over 13 million tons of traffic moved on this waterway in 1962.

The T.V.A. today has 31 major dams and hydro-electric plants and ten steam plants with installed capacity of 12 million kW of which 4 million kW is hydro and 8 million kW is steam, producing 60 billion kWh of power. The generating capacity of the T.V.A. amounts to 8% of the total U.S. capacity. The generation cost of its power is 2.1 mils (1.01 nP) per kWh against 4.2 mils (2.02 nP) of private utilities in the U.S.A.

Hydro and thermal

In 1951, eighteen years after start of construction work, about 85% of the power produced by the T.V.A. came from hydro-electric plants and the balance 15% from steam electric plants, *i.e.*, 2.872 million kW hydro and 0.638 million kW thermal, or a total of 3.51 million kW. By the end of 1955, the T.V.A. system was supposed to reach 9.4 million kW of which slightly over 60% would be steam electric. The great expansion of thermal generation began when most of the hydro potential had been developed and the growth in the electricity needs of the people went beyond the river's ability to produce hydro power.

Achievement

The T.V.A. transformed the entire economy and life of the people living in the Tennessee valley, covering 80,000 sq. miles in seven States. One of the most poverty-stricken and backward areas in the U.S.A. in the thirties of this century (as Orissa is today) is now throbbing with life and is among the most prosperous regions in the U.S.A.

—progressive in agriculture, power, industry, navigation, fisheries, inland recreation, and in living standards.

The Master Plan of Orissa

The 1963 Master Plan of Orissa will do all that and more. Estimated to cost Rs. 1,621 crores, it will provide complete control of floods of the Mahanadi, Brahmani and Baitarani Rivers ; 1.25 million acres of reservoir area for inland recreation, tourism and fish culture ; 1,230 miles of navigable inland waterways of say 9 ft. draft running through the whole length and breadth of Orissa and terminating at Haldia port in West Bengal and Visakhapatnam in Andhra with links to Paradeep port and the proposed Santrapur port in Chilka Lake ; 17.44 million kW of installed power capacity (8.44 million kW hydro and 9 million kW thermal) ; and what is more, irrigation water to 11 million acres (9.8+1.2) of crops (*kharif* and *rabi*), of which 9 million acres will be in Orissa and about one million acres each in West Bengal and Andhra—in other words, 44% greater installed power capacity than the T.V.A. and 11 million acres of irrigation crops against none in the T.V.A.

Rs. 825 crores component-combination of Master Plan (C.C.3)

A more realistic comparison will be with the component-combination C.C.3, comprising all new projects for the development of the water resources of Orissa for purposes of flood control, irrigation, power, navigation, fish culture, tourism, etc., with 250 MW of additional thermal power generation at Talcher.

This component-combination is estimated to cost Rs. 825.46 crores (total cost of T.V.A. Rs. 842 crores) and will provide :

Complete flood control of the Mahanadi, Brahmani and Baitarani Rivers ;

1,250,000 acres of additional reservoir area for fish culture, inland recreation and tourism.

1,230 miles of navigable inland waterways ;

A new port at Santrapir in Chilka Lake ;

7.74 million kW of additional installed power of which 0.25 million kW will be thermal at Talcher and the remaining hydro ; and

8.5 million acres of new irrigation (*kharif* plus *rabi*), of which 7.5 million acres will be in Orissa and about 1 million acres each in West Bengal and Andhra ;

the figures of power being over twice those in the T.V.A. in 1951 and somewhat less than those in 1955, the figures of irrigation being 8.5 million acres against none in the T.V.A.

Rs. 469 crores component of Master Plan

The most attractive component C.C.2, which should be considered and undertaken for implementation forthwith, consists of projects under Group A (serial 2, Table 7), estimated to cost Rs. 469.31 crores and to provide benefits :

Complete flood control of Mahanadi River ;

654,000 acres of reservoir area for fish culture, recreation, tourism, etc. ;

6.5 million acres of irrigation (*kharif* plus *rabi*) of which 2 million acres will be in Bengal and Andhra ;

4.54 million kW of installed power; and

795 miles of navigable waterways and the new Santrapur port all linked to Haldia, Visakhapatnam and Paradeep ports.

Rs. 175 crores sub-component

Of the Rs. 469 crores component of the Master Plan, the part of which must be taken up for construction immediately is the Tikerpara power project, estimated to cost Rs. 175 crores. This component will provide:

Complete flood control of Mahanadi River; and

654,000 acres of reservoir area for fish culture, recreation, tourism, etc. but no irrigation.

This sub-component is dealt with in greater detail in the pages that follow.

Priorities and programme of implementation

The priorities in broad terms are indicated in Table 3 and consolidated in Table 7. The first priority goes to the Tikerpara-Gania project and the Tikra project under group B. A further description of this group is given in subsequent pages.

The generation of thermal power beyond 500 MW at Talcher will come last in order of priorities, but if thermal power is to be generated based on middlings, this can be developed as required but will be outside the Orissa Plan.

Assuming that financial resources will be available to the extent indicated in Table 8, the schematic programme of implementation may be somewhat as given in that table.

Tikerpara-Gania project

This project will consist of

(i) Tikerpara Dam across the River Mahanadi, 100 miles downstream of Hirakud;

(ii) Gania Barrage, 22 miles downstream of the Tikerpara Dam;

(iii) Right bank irrigation-*cum*-navigation canal from the Gania Barrage passing through Puri and Ganjam Districts over barrages at the river crossings and terminating possibly at Visakhapatnam port;

(iv) Left bank irrigation-*cum*-navigation canal crossing the Brahmani, Baitarani, Subarnarekha and other minor rivers over barrages and terminating at Haldia port;

(v) Power plants and locks at the various falls; and

(vi) Pumping stations for lift irrigation on both canals.

The Tikerpara Dam will be in three parts: (i) a masonry dam across the main river channel 4,170 ft. long at crest, (ii) a masonry or possibly rockfill dam, 70 ft. high and 820 ft. in length at crest, and (iii) a masonry or possibly a rockfill dam, 120 ft. high and 5,000 ft. long at crest. The crest level of the dam will be at elevation 450 and reservoir level at elevation 430, the same as the tailrace water level of the Chiplima power station, which will provide a gross storage of 47 million acre-ft. and a live storage of 38 million acre-ft., with a waterspread of about 1,000 sq. miles.

The capacity of each length of canal, the full supply levels, falls, power installed, pumping lifts, and details of irrigation are given in Table 9 and Fig. 4.

There are some noteworthy features of the right bank canal. It will feed two major power plants, one at Tulsipur (discharge 12,200 cusec., head 96 ft., and installed power capacity 279 MW) tailing into the Mahanadi River above Mundali weir; the second at Tangi (discharge 29,160 cusec., head 166 ft., and installed power capacity 1,250 MW) tailing into the Chilka Lake through a 40 ft. deep channel into the sea. At the mouth of this tail channel will be a deep seaport, the Santrapur port. The Chilka Lake will be divided by this channel and its bund on its south bank into two parts—one of fresh water in an area of about 80 sq. miles, and the balance of brackish water. The lake will be developed for fresh water and brackish water fishing and for industrial establishments on its periphery.

The actual distribution of water supplies between the Tulsipur and Tangi Canals and power houses will be adjusted to suit the needs of irrigation and the maintenance of proper regime of the Mahanadi River below Mundali weir.

Tikerpara power project

In view of the limitation of funds, as also of the urgency of making a start with the construction of parts of the Tikerpara-Gania project, it is proposed to take up this very large project as two separate projects, *viz.*,

The Tikerpara Dam power project—purely as a power project; and

The Gania Barrage project—as an irrigation-*cum*-power project;

and also to implement each project in stages, such that each stage on completion starts bringing substantial benefits and financial returns and enables implementation of the subsequent stage or stages later without involving technical and constructional difficulties or undue additional expenditure. Also, the aim is to utilize the returns from an earlier stage of the project for financing a good part of the expenditure for the next stage.

The Tikerpara-Gania project has accordingly been studied as two separate projects. Also, each of the two projects has been studied for construction in stages in line with the requirements set forth above. This study has confirmed that stage development is economical and technically feasible in respect of both projects.

In respect of the Tikerpara project, the returns from the first stage will provide some resources for the implementation of its second stage, and, from the second stage, ample resources for the implementation of the other component units of the Master Plan.

There will be a return of

Rs. 3.95 crores per year on completion of stage I, estimated to cost Rs. 108.15 crores; and

Rs. 39.45 crores per year on completion of stage 2 (final stage), estimated to cost Rs. 174.97 crores (see Table 10).

This study has also revealed that the construction of the Tikerpara Dam must be the very first work to be taken up, whether it be the project for generation of power at Tikerpara or the project for the extending of irrigation from the Gania Barrage canal system and the development of power on that system.

The Tikerpara power project will, as indicated above, be completed in two stages :

The first stage to comprise construction of the dam to optimum minimum height, which will enable maximum generation of power with minimum submergence of land, thus keeping the capital investment to the barest minimum and at the same time bringing substantial financial return ;

The second stage to comprise construction of the dam to the full height and the installation of power units to full design capacity, in other words, the completion of the project in every respect. At this stage, the entire area under the reservoir at full design level will have to be submerged and full expenditure incurred on compensation and rehabilitation.

Stage 1

The optimum minimum level of storage in the first stage works out to elevation 355. With a spillway crest at elevation 340, the maximum flood of 2.7 million cusec., which is supposed to occur once in 1,000 years, will rise to maximum elevation 373 and will stand at that level for a couple of hours. The Sonepur town which is at elevation 370 and above will, therefore, remain above the maximum flood rise. Its lower lands may, however, have to be protected by an embankment of no more than 5 ft. high.

Land in the first stage may be acquired to R.L. 355, to which level the reservoir can be filled when the floods have passed. It may be noted that the flood discharge considered above is of the magnitude of 2.7 million cusec., as against the maximum observed flood discharge of 1.36 million cusec. This latter flood will not rise appreciably above elevation 355.

The dam will be constructed to full section from foundations up to spillway crest level elevation 340 in the spillway portion and up to safe level elevation 380 or 40 ft. above crest level for the rest of the dam to prevent overtopping during maximum floods.

For obtaining a reservoir level of 355, shutters 15 ft. high will be installed as a temporary measure over the spillway crest in the river bed and the spillway at saddle 1.

All penstocks will be installed in the entire power dam including portions where generating units are to be installed after stage 1.

All the work in connection with the power house up to about elevation 190 will be completed, including the tailrace channel. This latter becomes necessary to permit the construction of the Gania Barrage, with its designed pond level at 183, being undertaken at any stage. Once the barrage is constructed, the pond level cannot be lowered below 183, otherwise both irrigation and power generation from the canal system will either stop entirely or be seriously affected.

Also, the Gania Barrage must be completed as far as possible before the first stage of the dam becomes operative. If the barrage were to be constructed ahead of filling up the reservoir for the stage 1 of the dam, its closing phase of construction will have to deal with a manageable river discharge of about 9,830 cusec. as released from the Hirakud Dam. If the barrage is constructed after completion of stage 1 of the dam, its closing phase of construction will have to deal with about 23,820 cusec. discharge. This will be quite a big discharge and difficult to handle. But when the dam is completed and the final stage becomes operative, the final closure will have to deal with a discharge of about 55,000 cusec., a most difficult and expensive undertaking. It will, therefore, be necessary to complete the river part of the barrage, simultaneously with the filling of the reservoir for stage 1. A provision of Rs. 8 crores has been made for this.

The costs and benefits of stage 1 and stage 2 are given below.

Table 10

Costs and benefits

	Stage 1	*Stage 2*
Reservoir levels ..	355	430
Capital cost		
Civil works (Rs. crores) ..	43.96	50.26
Land (Rs. crores) ..	25.00	55.00
Electrical works (Rs. crores) ..	30.45	54.83
Overhead charges (Rs. crores) ..	8.74	14.88
Total ..	108.15	174.97
Power		
Firm power at 100 load factor (MW) ..	286	825
Installed capacity (MW) ..	750	2000
Peak availability (MW) ..	558	2000
Maximum demand at 70% load factor (MW) ..	409	2000
Cost of generation per kWh (nP) ..	2.53	1.46
Financial returns		
Receipts at Rs. 250 per kW-year of maximum demand (Rs. crores)	10.2	50.00
Interest, maintenance, depreciation, etc. per year (Rs. crores) ..	6.25	10.44
Net return per year (Rs. crores) ..	3.95	39.56

Stage 2

The works left over after the completion of stage 1 will be the completion of the dam in the river section to full height; the construction of masonry or rockfill dams over saddles 2 and 1; and the installation of the remaining power units. The additional cost involved in this will be as below (see Table 10):

Civil works	.. Rs.	6.30 crores
Land	.. Rs.	30.00 crores
Power generation	.. Rs.	24.38 crores
Overhead charges	.. Rs.	6.14 crores
Total	.. Rs.	66.82 crores

The cost of completing the entire dam and ancillary works after completing stage 1 will thus be only Rs. 6.3 crores, which can well be finished in a year. After the reservoir is raised gradually, the installation of power units can continue to suit load demands and the reservoir level proposed for the year, and thereby the investment on power and expenditure on land acquisition and rehabilitation can be spread over a longer period.

In view of the present acute power shortage and the mounting demand of anticipated loads of industrial and other undertakings already approved or likely to be approved, there is every likelihood that the 409 MW of available power (at 70% load factor) in stage 1 will be committed even before it becomes actually available, and that there will be a pressing need for the installation of additional units. Since the dam can be completed in a year or so after completion of stage 1, the work of substructure of the power house, including penstocks (embedded parts having been already completed under stage 1), and the installation of additional units to the full capacity of 2,000 MW will be a relatively simple matter, the total additional cost involved in electrical installations being Rs. 24.38 crores.

As will be seen from Table 10, the gross return on completion of stage 2 will be Rs. 50 crores a year. Deducting Rs. 10.44 crores for interest, maintenance and depreciation costs per year, the net return will be Rs. 39.56 crores a year.

This net return of nearly Rs. 40 crores a year will transform the economy of Orissa into a self-generating one, enabling the balance of the Master Plan to be largely executed with the resources generated from the Tikerpara power project.*

Resettlement and rehabilitation

For the resettlement and rehabilitation of the displaced persons, it is proposed to reclaim Government lands, as far as possible close to the original habitations which will be submerged, and in all cases, to provide such new areas with irrigation facilities, set up model villages or townships with appropriate industries and technical high schools, and to so arrange the programme of reclamation and rehabilitation that the displaced persons will have the option of moving into their new homes, farms or factories one or two years in advance of the date of actual submersion. This will ensure smooth and orderly movement of the people from the old to the new surroundings, which latter will be better and have better facilities for gainful employment.

The reclamation, building and industrial works will, as far as possible, be carried out by those who will be displaced, who will be encouraged to work in the reclamation of fields and building of homes which will ultimately be theirs, and on building schools and factories in which they will get training, and, finally, employment. This will give the displaced persons a feeling of participation and a sense of belonging, and, at the same time, a definite fillip to rural industrialization and rural uplift.

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* The figures of costs and returns will be somewhat modified as a result of more detailed designs and estimates, and changes in the assumption of sale price per unit or per kW-year of electric power, as also of any additional cost on account of high voltage transmission lines.

A sum of Rs. 25 crores has been provided for acquisition and rehabilitation for stage 1 and an additional Rs. 30 crores for stage 2 of the project, making a total of Rs. 55 crores.

Large areas of cultivable lands have been located in the forest areas of Dhenkanal, Sambalpur, Bolangir and Phulbani Districts and plans for providing irrigation water to these from medium irrigation projects are under investigation and finalisation. These areas will be mostly on the fringes of the Tikerpara reservoir and therefore not far from the areas to be submerged. The search for similar other areas located somewhat further away, but with possibilities of being provided with irrigation water, is in progress.

Diversion of water for irrigation in Madhya Pradesh

About 26,880 sq. miles of the catchment area of the Mahanadi lies in Madhya Pradesh. Only a small quantity of water of that catchment has so far been tapped for purposes of irrigation in that State, although considerable areas in it may be in need of irrigation. Further diversions of the Mahanadi waters for irrigating these areas and for power generation in course of time are, therefore, inevitable.

Any storage for power in Madhya Pradesh will add to the flood control and power potential at Tikerpara and help save flood waters in wet and very wet years being wasted to the sea. But any diversions for irrigation which involve consumptive use of waters will reduce the availability of water and may, therefore, affect to some extent the power potential at Tikerpara. This may not happen for 15 to 25 years from now. The reduction in quantity of water supply would be of no consequence so far as irrigation is concerned, as a good deal of water will, in any case, have to be escaped to the sea through the Mahanadi River or the Chilka Lake. But the reduction in power potential as a result of reduced storage will need to be made up if the industrial and economic structure built on designed power availability has to be maintained at peak level. Fortunately, it will be possible to take care of this deficiency in full and more by the diversions of the Brahmani waters after the construction of the Barakot Dam (Group D), the work on which would, it is hoped, start soon after the completion of the Tikerpara Dam.

Tikerpara—a national power project

The Tikerpara project, with its potential for installation of nearly 3,000 MW (at 30% load factor) and later more when Indravati and Barakot Dams and reservoirs with regulated discharges of 3,000 and 15,000 cusec. respectively, are constructed and the waters of these (about 18,000 cusec.) diverted into Tikerpara Lake, is one which can serve not only Orissa, but all the neighbouring States, *viz.*, West Bengal, Bihar, Madhya Pradesh, Andhra, and possibly Uttar Pradesh and Maharashtra. In integration with the proposed thermal power generation based on Talcher coal and middlings from the Bihar-Bengal coalfields, the Tikerpara power station, which by itself will generate about the cheapest power, can enable maximum utilization of the entire thermal capacity and its own, thereby making available in the aggregate much greater and cheaper useable power than would be the case if the two sets of stations were to work in isolation.

Hydro power, as stated earlier, is much cheaper to generate than thermal power and should have the highest priority.

It has been stated that by the end of the Fourth Plan the availability of middlings from the washeries will rise to 20 million tons which will be enough to provide fuel for a 5-million kW thermal generating station. These middlings must necessarily be used to avoid national waste. But to back up this thermal generation, steps must simultaneously be taken to develop hydro power, where it can be done in quantity and at cheap rates, to secure maximum utilization of installed capacity, thermal as well as hydro, and minimum cost of generation. As to what hydro power has to be developed to provide the correct system balance between hydro and thermal for maximum utilization will depend on the nature and location of loads.

The Tikerpara power project affords an ideal opportunity for developing such hydro power to provide a rational system balance between hydro and thermal.

Therefore, apart from its own intrinsic justification in points of cost and returns, its immediate development becomes a necessity in the wider interests of the region and the country, in order that power becomes available as needed and at reasonable cost and there is no recurrence of the chronic power famine in the eastern region, which presently is standing in the way of industrial development.

Table 11

Salient features of Tikerpara power project

1. *General*

Maximum estimated flood	2.70 million cusec.
Maximum observed flood	1.36 million cusec.
Maximum observed flood level	R.L. 230.00
Minimum water level	R.L. 173.00
Lowest bed level	R.L. 145.00
Rock bed level (average)	R.L. 140.00
Width of river at R.L. 176	1,460 ft.
Width of river at R.L. 450	4,170 ft.

2. *Reservoir*	*Stage* 1	*Stage* 2
Top of dam	R.L. 380.00	R.L. 450.00
Maximum water level	R.L. 373.00	R.L. 440.00
Full reservoir level	R.L. 355.00	R.L. 430.00
Spillway crest level	R.L. 340.00	R.L. 395.00
Dead storage level	R.L. 315.00	R.L. 330.00
Storage capacity at F.R.L.	14.0 million acre-ft.	47.0 million acre-ft.
Live storage	7.4 million acre-ft.	38.0 million acre-ft.
Regulated perennial flow	23,820 cusec.	55,000 cusec.
Average head for power	168 ft.	210 ft.

Table 11 (*contd.*)

3. *Main dam*	*Stage* 1	*Stage* 2
Total length at top of dam	3,900 ft.	4,170 ft.
Non-overflow dam (including power dam) ..	1,920 ft.	2,190 ft.
Spillway (central) ..	1,980 ft.	1,980 ft.
Saddle spillway ..	1,500 ft.	Nil
Saddle dams		
1 ..		5,000 ft.
2 ..		820 ft.
4. *Power*		
Firm power at 100% load factor ..	286 MW	825 MW
Installed capacity ..	750 MW	2,000 MW (rising to 3,000 MW)
Average tailwater level		
Post-Gania Barrage ..	R.L. 185.00	R.L. 185.00
Pre-Gania Barrage ..	R.L. 175.00	R.L. 175.00
Estimated cost—dam and power plant	Rs. 108.15 crores	Rs. 174.97 crores
Cost of generation per kWh ..	2.53 nP	1.46 nP*
Maximum demand at 70% load factor ..	409 MW	2,000 MW
Charge per kW per year of maximum demand	Rs. 250	Rs. 250
5. *Financial*		
Capital cost—civil works	Rs. crores	Rs. crores
A. Preliminary ..	0.32	0.32
C. Civil works ..	33.10	39.40
K. Buildings ..	2.43	2.43
O. Miscellaneous ..	2.67	2.67
R. Communication ..	5.44	5.44
Total civil works ..	43.96	50.26
Cost of land ..	25.00	55.00

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*This is with entire cost charged to power. If Rs. 40 crores are charged to flood control and irrigation, the cost of generation per kWh will be 1.17 nP.

Table 11 (*contd.*)

	Stage 1	*Stage* 2
Capital cost—electrical works		
1. Penstocks	3.83	3.83
2. Power house substructure including embedded parts of turbine	7.50	20.00
3. Civil works for power plant	7.50	
4. Power plant	9.00	24.00
5. Switchgear	2.62	7.00
Total electrical works	30.45	54.83
Overhead and miscellaneous items		
(a) Maintenance during construction	0.74	0.74
(b) Establishment T and P, audit, and other unforeseen charges	8.00	14.14
Total, overhead and miscellaneous	8.74	14.88
Total cost—dam and power plant	108.15	174.97*
Gross receipts per year	10.20	50.00
Fixed charges per year (for interest, maintenance, depreciation, and interim replacements)	6.25	10.44
Net return per year	3.95	39.56

Table 12

Tikerpara reservoir levels, areas and capacities

Elevation	Area, acres	Capacity, million acre-ft.
310	119,000	6.00
315	132,500	6.60
320	145,000	7.40
325	158,000	8.20
330	171,500	9.00
335	185,000	9.85
340	201,000	10.75
345	217,000	11.65
350	237,000	12.75
355	257,500	14.00
360	278,000	15.75
365	302,500	17.50
430	640,000	47.00

*Entire cost charged to power and none to flood control or irrigation.

Table 13

Tikerpara Dam—cost of works

	Stage 1	Stage 2
Reservoir levels ..	355	430
Civil works	Rs. lakhs	
A. Preliminary investigation and exploratory and surveys	32.00	32.00
B. Land ..	2,500.00	5,500.00
C. Works		
(i) Spillway excavation ..	121.68	121.68
Concrete and masonry ..	1,350.89	1,436.79
Sluice gates ..	12.00	12.00
Piers and bridges ..	—	12.60
Crest gates ..	—	71.00
(ii) Power dam :		
Excavation ..	26.82	26.82
Concrete and masonry ..	406.24	452.24
(iii) Non-overflow dam		
Excavation ..	24.96	24.96
Concrete and masonry ..	185.84	235.84
(iv) Training		
Walls ..	40.00	40.00
(v) Tailrace ..	286.00	287.00
(vi) Drilling and grouting ..	100.00	100.00
(vii) Dewatering arrangements ..	75.00	75.00
(viii) Saddle dam (rockfill) ..	—	352.00
(ix) Miscellaneous and unforeseen items ..	50.00	50.00
Total of works ..	3,310.00	3,940.00
K. Buildings: Residential and non-residential ..	243.00	243.00
O. Miscellaneous ..	267.00	267.00
R. Communications ..	544.00	544.00
Grand total except B, i.e., land ..	4,396.00	5,026.00

Hydro-electric works			
1.	Penstock ..	383.00	383.00
2.	Power house substructure to elevation 190, including embedded parts of turbine ..	750.00	—
3.	Civil works for power plant ..	750.00	2,000.00
4.	Power plant ..	900.00	2,400.00
5.	Switchgear ..	262.00	700.00
	Total electrical works ..	3.045.00	5,483.00
	Overheads and miscellaneous items such as establishment, T and P, audit, and indirect charges losses in stock, etc. ..	874.00	1,488.00
Grand total of dam and power plant ..		10,815.00	17,497.00

Table 14

Tikerpara Dam—abstract of cost of civil plus electrical works

		Stage 1	*Stage 2*
Reservoir levels ..		335	430
Cost of works		Rs. crores	
1.	Civil works (Table 2) ..	43.96	50.26
2.	Cost of land (Table 2) ..	25.00	55.00
3.	Hydro-electric installations ..	30.45	54.83
4.	Overheads and miscellaneous ..	8.74	14.88
Total cost of dam and power plant ..		108.15	174.97

Table 15

Fixed charges per year (on interest, maintenance and depreciation) (based on U.S. Bureau of Reclamation Memorandum No. 1 Electrical Power Costs and Values)

		Stage 1	*Stage 2*
Reservoir levels		355	430
		Rs. crores	
Capital cost		108.15	174.97*
Annual costs			
1.	Interest at 4.5% ..	4.86	7.85
2.	Depreciation (life of project 50 years amortization) at 0.50% of investment ..	0.61	0.98

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*Total cost charged to power and none to flood control or irrigation.

Table 15 (*contd.*)

3. Interim replacement at 0.20% of investment	0.22	0.35
4. Maintenance costs at Rs. 7.62 per kW for 625 MW installed and at Rs. 6.32 per kW for 2,000 MW installed	0.57	0.57
Total fixed charges	6.25	10.44
Units generated, million kWh	2,470	7,120
Cost per units generated, nP	2.53	1.46*

Prevailing tariffs in Orissa for power from Hirakud grid

Aluminium	
First 25 MW	Rs. 125 per kW-year of maximum demand
Second 23 MW	Rs. 166 per kW-year of maximum demand
Ferro-manganese	
First 7.5 MW	Rs. 210 per kW-year of maximum demand
Balance	Rs. 204 per kW-year of maximum demand
Caustic soda	Rs. 350 per kW-year of maximum demand
Low shaft furnace	Rs. 360 per kW-year of maximum demand
Cement factory, Railways, D.V.C., Bihar State	Rs. 550 per kW-year of maximum demand
Electricity Board	Made up of Rs. 5.50 per month plus energy charges at 8 nP per unit
Steel plant (Rourkela)	Reservation charge Rs. 120 per kW-year on peak demand, energy being supplied on demand and returned to the same extent any time during the month so that there is no actual consumption of Hirakud energy by the Rourkela steel plant.

An average rate of Rs. 250 or even Rs. 275 per kW-year of maximum demand would appear to be in order in the light of existing tariff given above.

Chilka Lake and Santrapur port

The Chilka Lake (*vide* Fig. 5) covers 450 to 500 sq. miles during the rains and about 350 sq. miles during the dry season. The water levels during these periods fluctuate between 3 and 6 ft.

The level difference between high tide and low tide is almost nil in the northern, central and southern sectors of the lake and ranges between 6 in. and 1.7 ft. in the outer channels and 4 to 6 ft. at the lake mouth.

The lake is connected to the sea at its north-east end, 2 miles north of Arakhakud (14 miles from Puri) through an opening 300 ft. wide and 6 to 30 ft. deep. A new cut is being excavated to connect the lake at its south-west end of the sea.

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* Total cost charged to power and none to flood control or irrigation.

The Daya and Bhargavi Rivers, two of the deltaic arms of the Mahanadi River, discharge their flood water into Chilka Lake. With the construction of the Tikerpara Dam, the flooding will be stopped completely and only regulated supplies will be passed into the lake, as required. Apart from these, there are only small *nullahs* discharging into the lake during the rains.

As a result of the present fresh water flood discharges into the lake, the salinity in its various sectors varies. The maximum variation is in the northern (Kalupara *ghat*) sector, which is affected by flood waters from Daya and Bhargavi, less in the central (Balugaon) sector, and least in the southern (Rambha) sector. The outer channels near the sea have, of course, the highest salinity content.

The salinity content of sea water is 32 parts per thousand. The optimum salinity content for brackish water fish is said to be 15 parts per thousand and for fresh water fish less than 1 part per thousand. Fresh water fish generally breed in the north sector and brackish water fish in the rest of the lake, though, with changes in salinity, there is migration of either type into the other sector.

The sale prices of fishes are said to be generally as follows:

Sea fish	.. Rs. 300 per ton
Brackish water fish	.. Rs. 1,000 per ton
Fresh water fish	.. Rs. 2,500 per ton

The lake yields about 3,500 tons of fish per year estimated to fetch about Rs. 60 lakhs. About 35,000 fishermen inhabiting 105 villages live around the lake.

The water depth in the lake ranges between 1.5 and 5 ft. in the north sector, 5 to 7 ft. in the central sector, and 7 to 12 ft. in the southern sector, the fringes in all cases being shallower. There appears to have been no appreciable change in the depths since 1860, except that some silting has taken place in the northern sector as a result of silt-laden water brought by the Daya and Bhargavi floods.

With the construction of the Ganis irrigation-*cum*-power-*cum*-navigation canal, there will be an average flow of about 29,000 cusec. (suitably adjusted to suit the regime requirements of the Mahanadi River) of fresh silt-free water passing through Chilka Lake more or less throughout the year. It is proposed to carry this water through a dredged channel about 36.5 miles long, about 40 ft. or more deep as need be, of which about 31 miles will be inside the lake and five miles outside it to the fall and power house near Tangi. The excavation from this channel will be deposited on its eastern side forming a continuous embankment 400 to 500 ft. wide, which will divide the lake into two parts, the eastern part having brackish water and the western part fresh water.

In the fresh water part, the level of water can be kept steady, if so desired, at or a couple of feet above high tide level by means of suitable navigation locks at the mouth of the channel. This fresh water part of the lake will be a potential port and protected harbour of about 80 sq. miles with about 32 miles of berthing space along the 40 to 50 ft. deep dredged canal, a sizeable sheltered harbour near Rambha completely protected from cyclones, and a liberal additional harbour area for accommodating ships, submarines, dockyards, shipyards, etc. This freshwater harbour area will also be available for rearing fresh water fishes through properly planned fish farms. Deep sea fishing trawlers can find a safe haven in this part of the lake.

The wide embankment along the outfall channel will provide a road and/or rail link from the Calcutta-Madras main railway line at the northern end of the lake to its southernmost end at its mouth into the sea. The area between the sea and the lake and the fringe areas on the land side of the lake will, with road, rail and water transport facilities provided, become available for setting up processing and heavy industries. Water for irrigation, domestic and industrial use can be supplied from the fresh water in the outfall channel.

The construction of the deep outfall channel has to be carried out in any case, as an integral part of the Tikerpara-Gania project for purposes of irrigation and power. The other facilities such as berthing for ships, harbour facilities, dockyards and shipbuilding, etc. are byproducts of this project and can be taken advantage of as and when the need for them arises.

It is felt that the mouth of the outfall channel will automatically remain clear almost to the excavated depth because of the perennial flow of about 29,000 cusec. of fresh and almost silt-free water. Should, however, it be decided to make use of the extensive harbour facilities already made available incidental to the irrigation and power project, and there be doubt about the width and depth of this mouth being maintained, the question of adding a breakwater or breakwaters can be considered at the appropriate time. The cost involved in this will be relatively small.

It may be noted that the five-fathom contour of the sea is within about half-a-mile of the shore.

Acknowledgments

Some of the general material has been taken from the 'Techno-Economic Survey of Orissa' (March 1962), published by the National Council of Applied Economic Research, New Delhi, and from 'An Economic Guide to Orissa', issued by the Tata Iron and Steel Co., Ltd.

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Summaries of Papers Published in the Journal Vol. 44; no. 6 pts. EL 3, CH 2 and PH 2, February 1964

ELECTRICAL ENGINEERING DIVISION

Operation of Three-Phase Induction Motors from a Single Phase Supply

R. K. Garg

Associate Member

This paper presents the idea of a phase conversion unit consisting of an auto-transformer and a variable capacitor to enable operation of three-phase induction motor on full performance and capacity from a single-phase supply. By adjusting the auto-transformer and capacitor settings, it is possible to obtain balanced three-phase operation at all loads, in the normal working range of induction motor. Mathematical analysis for such an operation is worked out and the results of its experimental verification are presented. The method opens out the possibility of future development which may result in extensive use of the system.

Generalized Circuit Theory of Electrical Machines—3 : Machines with Commutators

C. V. Govinda Rao

Associate Member

Commutator machines fundamentally belong to the class of a synchronous machines. Unlike induction motor it runs not only at sub-synchronous speeds but at super-synchronous speeds and synchronous speed. Structurally it differs from both synchronous and induction machines in that it replaces the rotor winding by a commutator winding. If the machine is designed for D.C., one of the members may have salient poles and the number of brushes generally equal the number of poles (cross-field

Commutator motors by the very nature of their construction differ widely in behaviour from induction and synchronous motors. They are asynchronous machines capable of infinite speed variation. This versatile behaviour is rendered possible by the combination of the commutator and brushes. This paper discusses phenomena of voltage and power in the commutator machines including conventional direct current machines. The paper highlights several results which are believed to be entirely new.

Oscillographic Method of Testing Insulating Materials

Dr. L. M. Hore

Non-member

The fast development of plastic insulation in cables necessitates introduction of new testing methods for insulating materials. It may occur that out of two materials of equal losses, one contains void, while the other does not contain any. We may observe different grades of polymerization in connection with two materials of equal losses. Thus the necessity of taking the oscillogram of dielectric loss current has become of great importance over and above the measurement of loss tangent. With the help of high voltage schering bridge, wide band amplifier, and oscilloscope in one set; and Dielectric coefficient and loss factor testing, R.C. audio-signal generator, selective amplifier, and oscilloscope in the other set, the oscillograms of dielectric current for a number of insulating materials with power and audio-frequency supply respectively have been taken to prove distinctively that the shape of loss current is a characteristic of the material itself. The paper gives the details of the results of the tests.

Analysis and Design for Satisfactory Governing of Hydro-Electric Stations

K. Madhavan

Associate Member

and

A. N. Singh

Non-member

In this paper, an attempt is made to focuss attention on the fundamental relationship between the factors which influence control of frequency of generating plants and to evolve procedure for quantitative calculation of the performance of hydro units in this respect. The calculations form an important part of the hydraulic studies necessary for the choice of elements of hydraulic system, *viz.*, surge tank, penstocks, pressure regulator, governor setting, inertia of machine, and may even influence the choice of the type of turbine. Such studies will ensure that the hydro-station will provide the response which is expected of it. Alternatively, in certain severe conditions, *e.g.*, plants with long penstocks, Kaplan turbines under low heads, it is possible to assess the restrictions that must be placed on the operation of plant consistent with economy.

Wind Power Potential in South India

M. Ramamoorthy

Graduate

The rapid industrialization of the country has created a serious shortage of power which is expected to persist for a long time. It is also becoming apparent that the conventional sources of power, *viz.*, coal, waterfalls, oil, etc., even if fully exploited, will not be able to wipe out power deficit in the country. Exploitation of natural phenomena peculiar to particular areas of the country is to be done for producing power. Generation of electricity by wind power has drawn serious attention throughout the world. Some research work on wind power is started in our country but its commercial utilization in the country is yet to come. This paper gives a study of wind flow and available wind power potential at several places in South India based on the records of the Regional Metrological Centre at Madras for the year 1961. The data and the calculations are expected to be of help to the entrepreneurs of wind mill construction in the region

CHEMICAL ENGINEERING DIVISION

Corrosion of Metals, Manufactured Articles and Equipment—2 : Corrosion of Equipment

(Mrs.) T. S. Shaha
Non-member

This is the second part of the paper on the subject of corrosion and is in continuation of the first part which has appeared in the *Journal*, part CH2, vol. 43, no. 6 February 1963. Here, the general classification of the corrosive processes and the damages caused by them, are described. The causes of corrosion, *viz*., defective design, defective manufacture of equipment and exposure of equipment to corrosive conditions, are analyzed. The corrosion protective methods are classified and a brief survey of the simple and convenient methods of corrosion test procedure, is made. The possible solution of the problem of corrosion is also indicated.

Utilization of Lignite Fly Ash from the 400 MW Thermal Station at Neyveli

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Large quantity of lignite fly ash from the 400 MW thermal station at Neyveli has now become available. Investigations so far conducted have shown that it can successfully be used in the making of hollow blocks and aggregate. It has also shown its utility as a binder for producing packaged fuels and as a flocculating agent. More investigations are under way to make light weight aggregate and other types of blocks with the fly ash.

PUBLIC HEALTH ENGINEERING DIVISION

Town Planning : Public Health Aspects

Dr. G. Ghosh
Non-member

Town planning is a special subject in which public health engineers are also interested. In this paper the basic principles of the subject have been briefly discussed, with a bias for public health.

Cost of Providing Sewage Treatment Plants Using High Rate Trickling Filters

M. L. Shah
Associate Member

The primary objective of a sewage treatment plant is the protection of health, to avoid nuisance and to prevent injury to receiving waters or land. During the last five decades, a number of engineers, chemists, and biologists have contributed to the scientific understanding of sewage treatment. There are a number of processes for sewage treatment. These are oxidation pond, chemical process, activated sludge process, trickling filters and others. Any of the above processes can possibly produce the desired final effluent, but the final choice of a particular process will depend upon many factors. The public health engineers, while designing a sewage treatment plant, should consider the treatment plant as a part of the comprehensive water pollution control programme of the region. Design factors *e.g.*, method and degree of treatment required, location of plant, cost of land, capacity of the plant, capital cost, recurring cost, etc., have an important bearing on deciding upon a most economical plant. One of the most important factors is the treatment plant cost. Based on certain design assumptions, this paper aims to present the costs of sewage treatment plants for population from 5,000 to 200,000 and the degree of treatment ranging from primary to complete. For oxidation step the trickling filters have been considered. The cost of a treatment plant would vary to some extent from one part to the other part of the country and hence figures given should be taken as a guide. The main purpose of this paper is to give figures that the designing engineer can use for budgetory purpose.

INSTITUTION NEWS

A Paper Centre at Rupnarainpur

The Council of the Institution have approved of establishment of a Paper Centre at Rupnarainpur under the auspices of the Bengal Centre of the Institution.

Visvesvaraya Regional College of Engineering, Nagpur

The Regional College of Engineering, Nagpur, has been renamed as Visvesvaraya Regional College of Engineering after the late Sir M. Visvesvaraya. The Government of Maharashtra with the concurrence of the Governing Body and the Government of India decided to effect this change of name. This is the first engineering college to be named after the eminent engineer.

Award of Prizes for 1961-62

The following prizes have been awarded for the year 1961-62.

(1) The President of India's Prize No award

(2) The Union Ministry of Irrigation and Power Gold Medal and Cash Award

The Union Ministry of Irrigation and Power Gold Medal and Cash Award for the best paper on civil engineering aspects of river valley development has been awarded to Shri N. S. Iyengar (*M.*) for his paper entitled 'Role of Reservoirs in the Solution of Flood Problems' published in the *Journal*, vol. 43, no. 5, pt. CI 3, January 1963. Shri Iyengar is Manager, Reservoir Operation, Damodar Valley Corporation, Maithon Dam.

(3) The Union Ministry of Irrigation and Power Gold Medal and Cash Award

The Union Ministry of Irrigation and Power Gold Medal and Cash Award for the best paper on power development and utilization has been awarded to Sharvashri S. S. Kumar (*M.*) and S. Rammohan (*M.*) for their joint paper entitled 'Power Development in the Eastern Zone' published in the *Journal*, vol. 43, no. 2, pt. EL 2, October 1962. Shri Kumar is Director General, Technical Development, Government of India, New Delhi, and Shri Rammohan is Director, Central Water and Power Commission, Government of India, New Delhi.

(4) The Railway Board's First Prize

This prize has been awarded to Sarvashri Kalicharan (*M.*) and S. K. Mazumdar (*A.M.*) for their paper entitled 'Construction of New Double Track Gandak Bridge' published in the *Journal*, vol. 43, no. 1, pt. CI 1, September 1962. Shri Kalicharan is Engineer-in-Chief (Construction), Eastern Railway, Calcutta, and Shri Mazumdar is Deputy Chief Engineer (Bridges), South Eastern Railway, Calcutta.

(5) The Railway Board's Second Prize

This prize has been awarded to Shri B. V. Sreenivasiah (*A.M.*) for his paper entitled 'Telecommunication Networks on Indian Railways—Progress and Problems' published in the *Journal*, vol. 42, no. 9, pt. ET 3, May 1962. Shri Sreenivasiah is Assistant Signal and Telecommunication Engineer, South Eastern Railway.

(6) Corps of Engineers Prize No award

(7) An Institution Prize

An Institution Prize has been awarded to Dr. R. Narayan Swamy (*A.M.*) for his papers entitled 'Behaviour and Ultimate Strength of Prestressed Concrete Hollow Beams in Bending' and 'Strength of Prestressed Concrete Beams under Combined Bending and Torsion' published in the *Journal*, vol. 43, no. 1, pt. CI 1, September 1962; and vol. 43, no. 5, pt. CI 3, January 1963. Dr. Narayan Swamy is Lecturer in Civil Engineering, University of Leicester, England.

(8) An Institution Prize

An Institution Prize has been awarded to Dr. H. R. Chablani (*A.M.*) for his paper entitled 'Predetermination of Electrical Characteristics of Steel Tubes at Power Frequencies 1 and 2' published in the *Journal*, vol. 42, no. 10, pt. EL 5, June 1962; and vol. 43, no. 10, pt. EL 5, June 1963. Dr. Chablani is with the Electrical Engineering Department, Maulana Azad College of Technology, Bhopal.

(9) The President of India's Prize for 1963-64 for the best paper in Hindi

This prize has been awarded to Shri Viswambhar Prasad (*A.M.*) for his paper entitled 'Valuation of Immovable Properties' published in the *Journal*, vol. 43, no. 5, pt. HI 1, January 1963. Shri Viswambhar Prasad is Personal Assistant (Rents), Central Public Works Department, New Delhi.

INSTITUTION NOTICES

Shri Jawaharlal Nehru Book Bank

It is hereby notified for the information of Students attached to the Mysore Centre that the Shri Jawaharlal Nehru Book Bank has been established at the Mysore Centre Office, 3 Vidhana Veedhi, Bangalore 1. This Book Bank is managed by the Mysore Centre and sponsored by the Ramnarayan Chellaram & Sons Charitable Trust. The Bank contains mostly text-books useful to Students pursuing course of studies for the Associate Membership Examinations of the Institution.

Students attached to the Mysore Centre and residing in Bangalore can enrol themselves as members of the Book Bank and borrow books by depositing a refundable security deposit of Rs. 15.

For particulars with regard to the procedure for borrowing books, Students are requested to contact the Honorary Secretary, Mysore Centre, at the Office premises during working hours, *viz.*, beteen 1.00 p.m. and 7.00 p.m.

Misdemeanour in the Institution Examinations

The Council have decided to cancel the results of the following candidate for the May 1963 examinations and debar him from appearing in the three immediately following examinations, *i.e.*, upto and including the November 1964 examinations for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 15226	1223 B	Titus Verghese

The Council have also decided to cancel the results of the following candidates for the November 1963 examinations and debar them from appearing in the two immediately following examinations, *i.e.*, up to and including the November 1964 examinations, for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 13070	3207 A	Bhopal Singh
S 17618	594 B	Shabda Prakash

Expulsion of Sarvashri D. K. Sawhney and Noorul Hassan from the Institution

As decided by the Council in their 432nd and 433rd Meetings held at Hyderabad on February 11, 1964, Sarvashri D. K. Sawhney (*Student*) and Noorul Hassan (*Student*) have been expelled from the Institution under provisions of Bye-law 42.

FORTHCOMING CONFERENCES

Training Programme for Establishment of Company Standardization, Mussoorie, May 6-19, 1964

To evaluate the status of in-plant standardization activities and to assist Indian Industries to establish and organize Company Standardization, the Indian Standards Institution has organized a number of training programmes at various industrial centres. This programme will provide detailed training in standardization methods and techniques. With a thorough indoctrination in basic principles and practices, the programme is designed to create a nucleus of company standards engineers capable of organizing standards activity in a company. To those companies which already have some standardization activities within their plants, the training will provide an excellent opportunity to assess and improve their present efforts along this line.

The programme will be of 2 weeks' duration, consisting of 40 sessions, out of which 36 sessions will be of 1 hour and 15 minutes each and the remaining four will be of 2 hours each or a total of 55 hours. In addition to formal lectures by the course conductors and guest speakers, trainees will be given opportunity to participate in group discussions and make presentations on assigned topics for evaluating the progress they are making in absorbing the prescribed curriculum. As a practical benefit to the participating companies the trainees will be asked to prepare reports consisting of recommendations to their own managements. Adequate guidance for the preparation of such reports will be provided during the session.

The fee for the course including charges for board and lodging and cost of handout material will be Rs. 1,000 per trainee. Non-residential trainees will not be accommodated. Interested firm may nominate for this training programme, candidates who have shown some initiative and organizing capability and have worked effectively with people at different levels within the company. Individuals with engineering degrees or other equivalent technical background should be given preference. Knowledge of cost control, statistical analysis, industrial engineering, production planning, product designing, purchase and inspection will be useful for obtaining maximum benefit from the programme. Upon successful completion of training, the trainees will be expected to make firm recommendations to their companies, and when authoritzed, be able to set up and operate organized standards activity or a department.

Further particulars and registration forms can be obtained from the Indian Standards Institution, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 1.

Inter-Disciplinary Symposium on 'Advances in Materials', Manchester, April 6-9, 1964

The Institution of Chemical Engineers will hold an inter-disciplinary symposium on 'Advances in Materials' in Manchester on April 6-9, 1964. The object of the symposium is to survey the latest developments in materials science and technology. The limitations imposed by materials on the progress of modern technology will be examined together with developments to meet the increasingly exacting requirements of industry. It is expected that the meeting will consider the subject on a broad front of modern technology and will not be restricted to the field of chemical engineering.

The symposium will be held in six sessions, and papers on the following subjects will be presented :

1. Industrial Needs and Influence on Design
2. New Concepts in Materials Science
3. The Materials
    - (i) Metallics,
    - (ii) Polymerics, and
    - (iii) Glass, ceramics and carbon
4. Processing Problems with New Materials

There will be an associated programme of industrial visits arranged on April 9, 1964. All papers will be preprinted for circulation before the meeting.

Further details can be obtained from the Secretary, The Institution of Chemical Engineers, 16 Belgrave Square, London, S.W. 1.

Second International Executive Course, Geneva, Switzerland, June 8-July 3, 1964

The Centre d'Etudes Industrielles is the oldest International Management Development Institute in Europe. Originally founded in 1946 by Aluminium Ltd., as a training centre for its managerial personnel, it has become an independent foundation since 1956, associated with the University of Geneva. It is open to any applicant who fulfills the admission requirements. The first International Executive course, organized by the CEI, was a success.

The programme has as its basic theme the 'Impact of Changing Environments upon Management'. The basic theme is divided into the following areas :

- (i) The changing economic environment ;
- (ii) The changing social environment and human behaviour ;
- (iii) The changing political and international environment ;
- (iv) Changing technologies and managerial techniques ; and
- (v) Management and organization.

The purpose and objective of the Second International Executive Course is to provide an opportunity for executives of diverse backgrounds and nationalities to review together the impact of changing environments on executive functions and responsibilities.

The course is open to executives of international companies from various countries. Participants are normally sponsored by their firms and are selected from the middle and higher ranks of management. The registration fee is $600. It covers tuition fee and study materials as well as mid-day meals for four days a week and/or occasional dinners.

The applications should reach the Secretariat at Geneva on or before March 31, 1964. Further details can be had from the Director, Centre D'Etudes Industrielles, 4 chenin de Conches, Geneva, Switzerland.

Fourth International Harbour Conference, Antwerp, Belgium, June 22-27, 1964

The Fourth International Harbour Conference will be held at Antwerp, Belgium, between June 22-27, 1964. The Subjects discussed during the Conference are: (i) Hydraulic Engineering in Harbours; (ii) Civil Engineering in Harbours; (iii) Soil Mechanics and Geology in connection with Harbour Construction; (iv) Port Equipment; (v) Safety Problems in Harbours; (vi) Handling and Transhipments of Goods; and (vii) Port Management. During the Conference, the participants have free access to visit the Zoological Gardens at Antwerp. Further details can be had from the Secretary, Ingenieurshuis, Jan Van Rijswijcklaan 58, Antwerpen (Belgium).

Seventh Congress of the International Association for Bridges and Structural Engineering, Rio de Janeiro, August 10-16, 1964

The Seventh Congress of the 'International Association for Bridges and Structural Engineering' (IABSE) will be held in Rio de Janeiro, from August 10 to 16, 1964. Only members of the IABSE may take part in the Congress. The theme of the Congress include: (i) New Trends in the Methods of Calculation, (ii) Structural Steels, Means of Connection, (iii) Special Problems (Shear, Prestressing, Prefabrication), (iv) Special Constructions for Steel Bridges, (v) Behaviour of Structures, and (vi) Structural Details in Highway Bridges.

The working sessions of the Congress will begin with a general survey of the general reporter. He will then indicate the most important points in each construction to the them and suggest the line to be followed in the prepared discussion. The contributions of other members which are included in the programme will not be presented by the authors at the Congress. It will be open to those taking part in the Congress to prepare a contribution to the discussion which must have some reference to the papers presented. The contributions to the prepared discussion should be notified to the Secretariat of IABSE in the form of a detailed summary in triplicate and with the necessary figures not later than June 1, 1964.

Further particulars can be obtained from the Secretary of the International Association for Bridges and Structural Engineering, Eidgenoessische Technische Hochschule, Zurich, Switzerland.

Second International Conference on Water Pollution Research, Tokyo, August 24-28, 1964

The Second International Conference on 'Water Pollution Research' will be held in Tokyo from August 24 to 28, 1964. The objectives of the Conference are given on page 60 of the *Bulletin* for November 1963. A preliminary programme is now announced.

World recognized authorities will share their work with the delegates. There will be three concurrent Symposia, each with 16 pages. The titles of the Symposia and their Chairmen are as follows :

(1) Stream Polution : Dr. O. Jaag (Switzerland)

(2) Waste Treatment : Prof. J. K. Banns (The Netherlands)

(3) Marine disposal : Prof. E. Pearson (U.S.A.)

There will be discussions on each paper by specialists. Copies of the papers and prepared discussions will be distributed to the meeting registrants. Abstracts of all papers are printed in the March 1964 issue of the *Journal Water Pollution Control Federation.*

Further details can be obtained from The Water Pollution Control Federation, 3090 Wisconsin Avenue, N.W., Washington, D.C., U.S.A.

International Symposium on 'Sensitivity Analysis', Dubrovnik, Yugoslavia, August 31-September 5, 1964

The International Symposium on 'Sensitivity Analysis', which is being organized by the Yugoslav Committee for Electronics and Automation and the IFAC (International Federation of Automatic Control) Committee on Theory, will be held in Dubrovnik, a seaside resort on the southern Adriatic coast of Yugoslavia, from August 31 to September 5, 1964. The symposium will be held as a series of round table discussions on the following four main topics.

1. General problems of sensitivity analysis—definition of sensitivity functions for systems with constant and time varying parameters ; sensitivity with respect to small parameters ; sensitivity to large parameter variations ; sensivity and feedback ; inverse sensitivity ; relation between sensitivity analysis and the theory of invariance.
2. Sensitivity and stability—relation between sensitivity and stability in the sense of Liapunov ; relation between stability of sensitivity equations and the stability of original system equations ; limit cycles in sensitivity equations ; sensitivity analysis and structural stability.
3. Methods of computing sensitivity functions—machine methods of computing sensitivity functions for linear and non-linear differential equations with constant and time varying parameters and finite number of discontinuities. It will be of interest to discuss specifically the sensitivity in linear control systems with constant parameters, sensitivity in control systems containing typical non-linearities, sensitivity in sampled data systems, etc.
4. Applications of sensitivity analysis—practical applications of sensitivity analysis to be discussed in this session may include the use of sensitivity functions in process identification and design of optimal and adaptive system ; design of insensitive systems ; parameter compensation ; iterative solution of boundary value problems ; development of insensitive computing methods ; investigation of errors in analog and digital computation.

Authors should forward the text of their paper to the Yugoslav Committee for Electronics and Automation by May 1, 1964, for review and distribution into appropriate sessions.

Further details and time-table of the symposium can be obtained from the Yugoslav Committee for Electronics and Automation, P.O.B. 356, Belgrade, Yugoslavia.

The Third International Measurement Conference IMEKO III and the Sixth International Instruments and Measurements Conference, (I & M VI) Stockholm, Sweden, September 14-19, 1964

In view of the growing intrest shown in professional circles of many countries towards International Measurement Conference I and II held in Budapest in 1958 and 1961 respectively, the Permanent International Preparatory Committee of the International Measurement Conference has resolved to accept the invitation of its Swedish Member Organization to organize the third International Measurement Conference simultaneously and jointly with the Sixth Instruments and Measurements Conference in Stockholm between September 14-19, 1964.

The aim of the Conference is to provide exchange of scientific experience, theoretical as well as practical, regarding technical and scientific problems in the field of measurement and instrumentation and to establish a personal contact among participants. Approximately 120 papers have been submitted by scientific and technical societies participating in the organization of the Conference from Bulgaria, Chinese People's Republic, Czechoslovakia, German Democratic Republic, Hungary, Italy, Japan, Poland, Roumania, Soviet Union, Sweden, the United Kingdom and the U.S.A. as well as by scientists in Austria, France, German Federal Republic, India, Israel, the Netherlands, United Arab Republic, and Yugoslavia.

Further details of the Conference can be obtained from IMEKO III and I & M VI, Reso Congress Service, Stockholm, Sweden.

Public Works and Municipal Services Congress and Exhibition, London, November 16-21, 1964

The 1964 Public Works and Municipal Services Congress and Exhibition will be held at Olympia, London, from November 16-21, 1964. This Year's show, the 26th in the series, will cover a total floor area of over 450,000 sq. ft. to fill all three exhibition halls and galleries of Olympia. The 1964 Public Works and Municipal Services Exhibition will provide a view of the latest plant, machinery, materials, ancillary equipment and services available to public and municipal authorities, surveyors, architects and civil engineering contractors both at home and overseas. Construction equipment to be exhibited at Olympia will include excavators, bulldozers, loaders, shovels, tractors, crawlers and dump trucks, together with wagons, trailers, grabs, buckets and scoops. Road-making machinery and materials will be shown, such as stone-crushing, screening and dressing machinery as well as presses for the forming of paving flags and kerb stones ; complete plants for producing asphalt or tar-macadam ; ready-mixed concrete plant, block-making and paving machines, concrete surfaces ; concrete weight-batchers, mixers, agitators and vibrators. Mechanical handling exhibits will constitute a vast array of cranes, hoists, elevators, winches, scaffolding, workplatforms, conveyors, lifting tackle, storage tanks and hoppers.

The display of water treatment and sewage plant will include clarifiers, separators, flocculators and sludge collectors ; filters, screens and sewage tank cleaners, trenching machines, ditch, drain and sewer cleaning equipment. Municipal vehicles such as street refuse sweepers and collectors will be featured, alongside snowploughs, snow blowers and road-gritting machines ; gully and cesspool emptiers, traffic signals, reflective kerbing, street lights and danger lamps ; parking meters, manhole covers and litter bins.

Other site equipment on show includes rock drills, air compressors, pneumatic tools, shovels and picks ; alternators, generators and welding sets, Diesel and petrol engines, electric motors and transmission units, together with pumps, pipes and valves for handling many differnt fluids and sludges. A variety of levels, pluments, flow recorders, level recorders and moisture meters will be amongst the instruments on show ; whilst many everyday products such as hedge cutters, wheelbarrows, roofing felts, sealants, floor surfacings, damp courses, anti-corrosion fluids and insulation materials will complete the display.

A specialized Congress is being organized to run concurrently with the Exhibition. Congress sessions will take place simultaneously in three conference halls at Olympia every morning and afternoon during the first five days of the show. The subjects to be featured in papers and subsequent discussions are being finalized by the Congress Council.

Further details can be obtained from Engineering in Britain, 12 Swallow Street, London, W. 1.

BOOK ACKNOWLEDGMENTS

1. **Estimating, Costing and Specification in Civil Engineering.** M. Chakraborti. *Published by the author,* 30 Nepal Bhattacharjee 1st Lane, Calcutta 26, Rs. 12.50. 280 pages.

This book is intended to help the beginners as well as practising engineers in the field of civil engineering. In the R.C.C. chapter informative notes with drawings have been arranged before sterting the detailed estimate. Endeavour has been made to characterize the individuality of different chapters, *viz.,* Water Supply and Sanitary Works, Division and Areas of Land, Analysis of rates, Roads, etc. Numerous examples including some question papers of both West Bengal and Bihar engineering degree and diploma courses have been solved. Included in this book are a number of estimates prepared both in F.P.S. and Metric System to bring home the subject to the students in both the systems.

2. **Reinforced Concrete—Theory and Design.** S. C. Neogi. Published by *Shri Suranjan Neogi*, 7 Ballygunge Terrace, Calcutta 19. Rs. 12.50. 281 pages.

This book although intended for the beginners will be useful to the practising engineers as well. The properties of concrete and steel have been dealt with in the beginning. In the later portion the subject has been developed gradually from fundamental principles to the simplest design of beams, slabs and columns, and then to the more difficult designs of retaining walls, watertanks and raft foundations, etc., ultimately leading to the recent developments in the field of reinforced concrete designs of complicated nature. The properties of concrete and the principles of design have been liberally illustrated in the book by the use of graphs, plotted from data shown in tables and the utility of such graphs and tables in the design of R. C. members have been pointed out. A good many number of problems both of practical and academic interest have been worked out in this book from fundamental principles.

3. **A Text-book of Railway Engineering.** P. K. Bhattacharjee and S. K. Basu. *Orient Longmans Ltd.*, Calcutta, Rs. 10.50. 210 pages.

Though the book is primarily meant for diploma students, degree students also will be much benefited by this. The subject matter have been divided in the following main heads : Projects and Profiles, The Permanent Way, Curves and Superelevation, Points and Crossings, Station Yards, Signalling and Interlocking and Maintenance. Other special features of this work are are profuse illustrations (including all signals in proper colours), the Railway Boards regulations where necessary, and the standard dimensions and summary of questions at the end of each chapter.

4. **Sanitary Engineering.** S. K. Basu and A. K. Ray. Edited by B. N. Chaudhuri. *S. K. Lahiri & Co. Private Ltd.*, College Street, Calcutta-12, Rs. 12, 261 pages.

This revised fourth edition of a book covers the syllabus of various examining bodies in India in sanitary engineering. Important topics like Activated Sludge Softening of Hard Water, Slow Sand and Rapid Gravity Filter, Prevention of Waste of Water, etc., have been dealt with in details with illustrations.

5. **Multibay Frames.** A. Kleinlogel and A. Haselbach. *Crosby Lockwood & Sons Ltd.*, 120 s. 469 pages.

Included in this comprehensive book, an invaluable time saver for the civil engineer, are conveniently arranged formulas for determining the bending moments, reactions, shears, and other significant quantities, under a number of different loading conditions and combinations (vertical and horizontal loading, point loads), for each of the ninety frame shapes in this versatile collection. The formulas for the frames with three or more bays can readily be extended to frames having any number of bays. The theoretical principles on which the formulas are based are very fully explained in the appendix. The use of these formulas in the actual design of a structure is certain to effect a substantial saving in time and effort as compared with any of the variants of the moment distribution method.

6. **Examples in Applied Mechanics.** R. S. Paradise and G. A. Church. *Blackie & Son Ltd.*, 10 s. 6d. 154 pages.

This book includes a wide range of problems carefully selected to cover all types. Good number of typical worked examples have beed worked out under different topics dealth with.

7. **Statistical Methods for Engineers.** J. J. Fleming. *Blackie & Son Ltd.*, 35 s. 146 pages.

In this introduction to the subject the author covers the needs of practising engineers and gives examples mainly drawn from highway and traffic engineering, for which statistical techniques are essential. Some worked out examples included in the book. Included at the end is a bibliography for further reference and study. The book is intended for the student as well as for the practising engineer, especially, in the fields of highway and traffic engineering.

OBITUARY

The sympathy of the Institution is extended to the relative of those whose passing is recorded here

Shri S. N. Bose

Shri Surendra Nath Bose, M.E., M.I.E.E., M.I.Mech.E., Fel. A.I.E.E., M.I.E., died in Calcutta on January 21, 1964. He was 88. He was a Member for life of the Institution.

Born in Allahabad in 1866, he obtained his technical education from the Victoria Jubilee Technical Institute, Bombay, passing the L.E.E. examination in 1908. He also obtained the M.E. degree of the Cornell University in 1917. During 1910-13 he worked as Student Engineer with the General Electric Co., New York, and for 8 years as Assistant Electrical Engineer with the J. G. White Engineering Corporation, Consulting Engineers, New York. In 1926 he joined the Tata Iron and Steel Co. Ltd., Jamshedpur, as Assistant Chief Electrical Engineer and became Deputy Chief Electrical Engineer in 1928 and was Chief Electrical Engineer from 1931 to 1947. He was later appointed Chief Electrical Engineer and Planning Officer, West Bengal Electricity Development, and Special Officer, Bokaro Thermal Power Station of the D.V.C.

Shri Bose joined the Institution as Member in 1934.

Shri V. A. Choudary

Shri Vellanki Akkayya Choudary, B.Sc.(Eng.), M.I.E., passed away at Vijayawada at the age of 63. He was a Member for life of the Institution.

Born in 1880 and educated at A.E.L.M. College, Guntur, he obtained his B.Sc.(Eng.) degree in Electrical and Mechanical Engineering from St. Andrew's University in 1923. For six months from January 1924 he worked as Improver in the

Electricity Department of the Corporation of Madras and was connected with the construction of sub-stations and laying out underground cables and overhead wires. Till November 1942 he worked as Inspector of Factories in various circles in the then Madras Presidency. During 1942 to 1947 he was Regional Inspector of Training (Technical) in Madras and U.P. regions. At the end of the year 1947 he became Deputy Director of Training (Technical) in the training scheme of the Ministry of Labour. During the years, Shri Choudary was responsible for organization, setting up and administration of technical institutes throughout India including the Central Institute for Training of Instructors.

Shri Choudary joined the Institution as Associate Member in 1934 and was transferred to Member in 1949.

Rai Bahadur S. C. Ghose

Rai Bahadur Subodh Chandra Ghose, A.M.I. Mech.E., M.R. San.I., A.M.I.E., died on December 28, 1963. He was 76.

He was born in Calcutta in 1887 and had his general education at the Calcutta University. He attended a course of lectures on the Technique of the Quantitative Bacteriological Analysis of Water at the Provincial Laboratory, Dacca, in 1912. In 1913, Shri Ghose passed the examination for the Certificate of Competency under the Madras Boiler Act. From 1907 to 1909 he worked as apprentice at the Dacca Electric Light Power Station and until he joined as Assistant Engineer in charge of mechanical works, Public Health Department in Bengal, in 1922, he had worked in several firms in various capacities in the erection and maintenance of boilers, pumping plants and water works. In 1942, he became Executive Engineer in which post he continued till his retirement in 1947.

Rai Bahadur Ghose joined the Institution as Associate Member in 1925.

Shri N. M. Gobhai

Shri Navroji Manekji Gobhai, L.C.E., M.I.E., died on October 27, 1963. He was 78.

Born in 1885, Shri Gobhai obtained his L.C.E. diploma from the Bombay University in 1905. He had a varied experience in the Bombay Port Trust and in the then State of Bikaner from 1906 to 1913. Since 1913, he was practising as Architect, Civil Engineer and Surveyor, and in those years he was responsible for the construction of several buildings and factories.

Shri Gobhai joined the Institution as Member in 1947.

Shri Hari Chand

Shri Hari Chand, C.E., M.I.E., passed away on December 23, 1963, at the age of 80. He was a Member for life of the Institution.

After graduating in Civil Engineering from the Thomason College of Civil Engineering in 1907, Shri Hari Chand joined the P.W.D., B & R Branch, U.P., as apprentice and became District Engineer in 1908. In 1909, he was promoted as Executive Engineer in which post he continued till his retirement in 1932. Shri Hari Chand joined The Concrete Association of India as District Engineer in 1932 and remained in that post till 1950. During his career, Shri Hari Chand was responsible for the designing of the Maha Bodhi temple at Sarnath and for the construction and maintenance of several roads, bridges and river training works in the then U.P.

Shri Hari Chand joined the Institution as Associate Member in 1922, and was transferred to Member in 1944.

Shri Hassan Marikar

Shri Hassan Marikar, B.E., A.M.I.E., died in a plane crash near Agra on September 11, 1963. He was a member of the Executive Committee of the Kerala Centre.

Born in 1916 at Munnar, Shri Marikar obtained his B.E. degree in Mechanical Engineering from the Madras University in 1939. After having worked as apprentice in the P.W.D. Workshop, Madras, for ten months, and in the Electricity Department, Trivandrum, for two months, he was appointed as Mechanical Engineer, Madura District Board, in 1940. In 1941, he was appointed as Examinar of Stores, Government Metallurgical Inspectorate, Tatanagar, and for about six months he worked as Lecturer, College of Engineering, Trivandrum. In 1943, he became General Manager of Marikar (Motors) Ltd., and subsequently in 1945, in addition he was Director and Engineer in charge of Marikar Engineers Ltd. During his career, Shri Marikar was responsible for the erection of machinery in the mechanical laboratory of the College of Engineering, Trivandrum, and four automobile workshops in South India.

Shri Marikar joined the Institution as Associate Member in 1944.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS WANTED

YOUNG ENGINEER, age 26 years, passed Sections A and B of the Associate Membership Examination of the Instititution of Engineers (India) and possesses first class diploma in civil engineering, having 4½ years experience in design, construction and maintenance of buildings, roads, culverts, planning of industrial estates; seeks suitable job at Ahmedabad, Baroda, Bombay or Delhi. Minimum salary acceptable is Rs. 400. (Office ref. E.S. 148)

SENIOR ELECTRICAL and MECHANICAL ENGINEER, B. Sc. (Engg.), M.I.E., available for immediate engagement in Calcutta, 35 years experience in large power stations in India and in the U.K. (Office ref. E.S. 149)

THE INSTITUTION OF ENGINEERS (INDIA)

Please note that the telegraphic address of the Institution of Engineers (India), 8, Gokhale Road, Calcutta 20, will be ENJOIND(P) instead of ENJOIND with effect from April 1, 1964.

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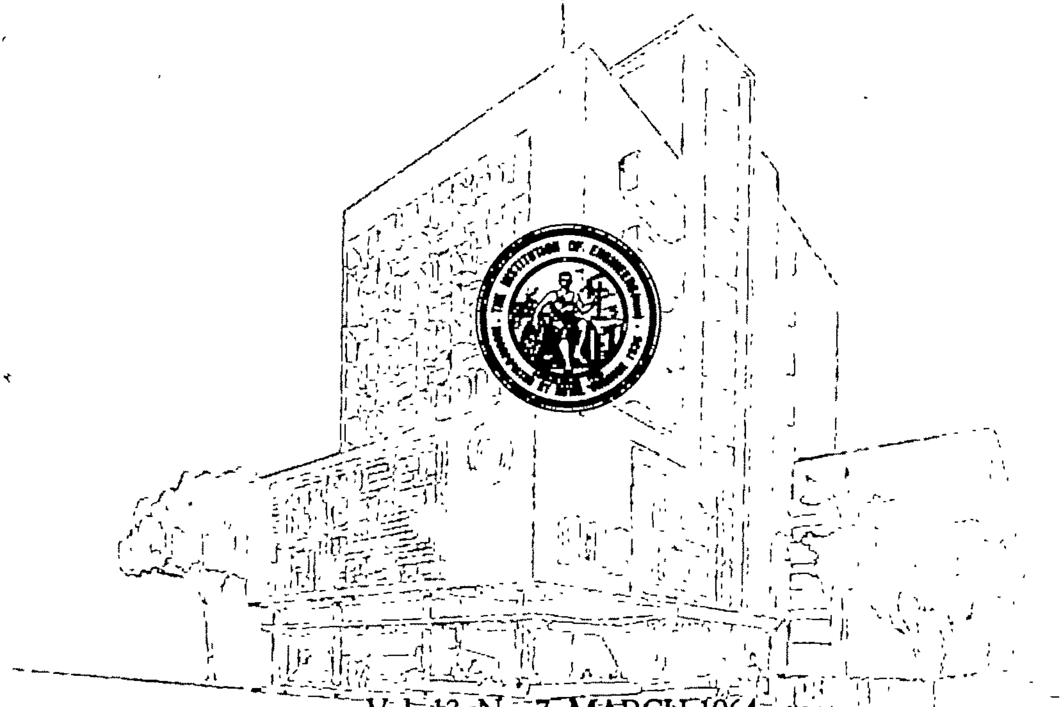

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Supplement to the *Journal of the Institution of Engineers* (*India*),
Vol. 44, No. 7, March 1964

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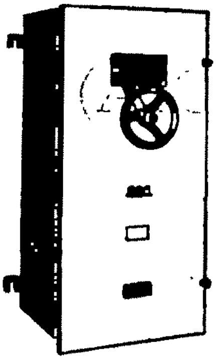

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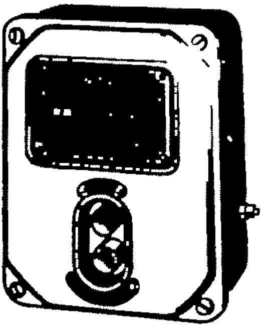

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NEW BUILDING FOR THE HEADQUARTERS OF THE INSTITUTION —AN APPEAL TO MEMBERS

Counting the years that have gone by and the progressive years that lie ahead, the Institution has started on an interesting march in the year 1964.

A new project is now on hand to solve a vexing problem—the serious deficit of essential accommodation for carrying out the functions the profession has been demanding—and the grounds of the Headquarters are resounding with the din and clatter of machinery and men. This is the preliminary for a new phase of construction work which is yet to commence—the building of a 9-storey structure (as seen in the artist's impression on the cover) that is to be the future home for the Headquarters.

The aim of this new facility is purposeful—to be able to provide efficient service and to add to the prestige and effectiveness of the country's engineering advance as a whole and thus to its cooperative strength.

The architects of the building are Ballardie, Thompson and Matthews of Calcutta, one of India's leading architectural firms and pioneers in this field.

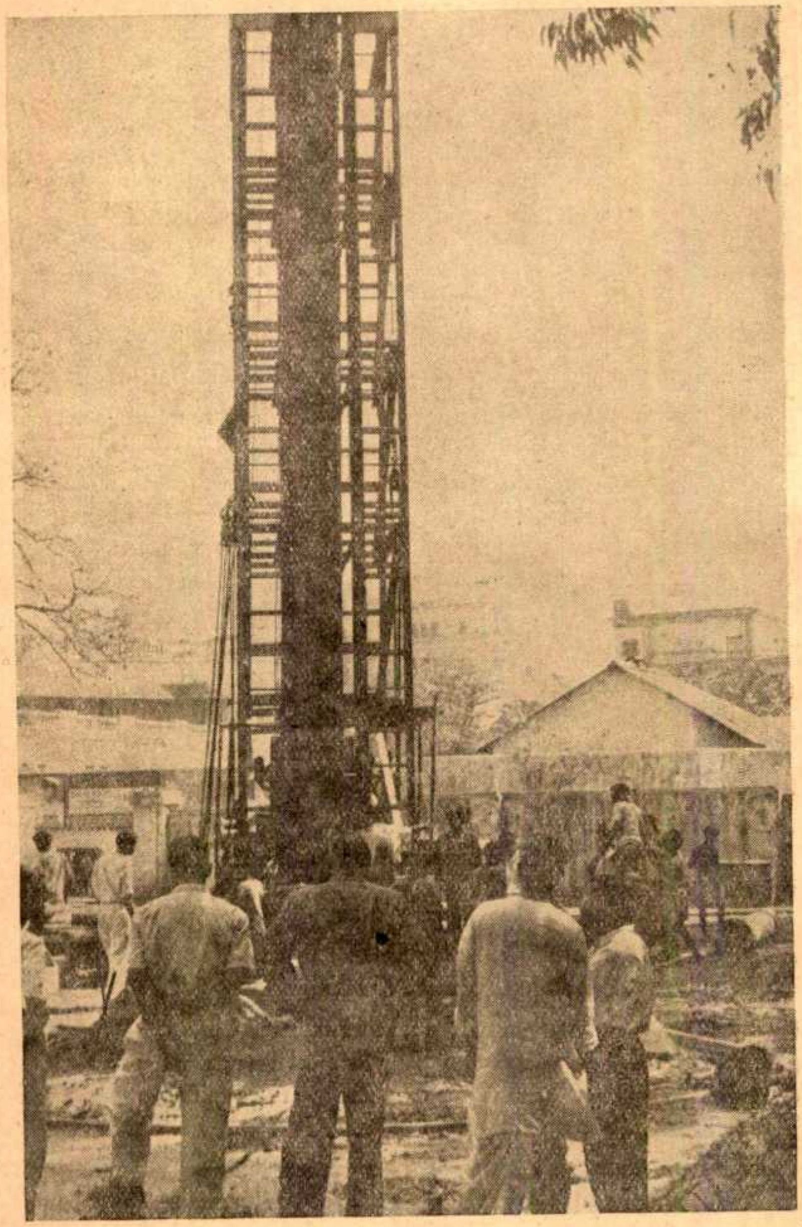
On the evening of Saturday, October 19, 1963, the site wore a festive and colourful look, with distinguished guests, well-wishers and friends bound in goodwill and common allegiance to the faith and values for which the Institution stands ; and the function that drew this big crowd was the Foundation Stone Laying Ceremony for the new building.

As a commencement of the schedule that has been laid out for this activity, the first of the 148 Simplex piles (which work has been entrusted to Messrs. Simplex Concrete Piles (India) Private, Ltd.) was struck at 10.40 a.m. on March 4, 1964, on a signal given by Shri Akshoy Bose, Senior Partner of Ballardie, Thompson and Matthews, who was a member of the Council for many years and a former Chairman of the Civil Engineering Division and whose record of service to the Institution over two decades is too well known for recounting here. Shown in the photographs are the installed pile and the pile-driver in action.

The new building will be of nine floors, and space has been carefully planned for the requirements of the various Departments of the Headquarters to meet their immediate and foreseeable needs for the next few years. The total floor area will be made up of: office 26,318 sq. ft., utilities 10,270 sq. ft., and a covered car park on ground floor 3,295 sq. ft. The total height of the building will be 108 ft. 6½ in. The estimated cost of the construction is Rs. 15 lakhs.

The foundation work is expected to commence shortly after the piling work is over, and the entire project is scheduled to be ready for final occupancy by December 1965. The work is in the charge of the Headquarters Building Committee comprising Dr. T. Sen (Chairman), Shri S. Bandopadhyaya (*M.*), Shri J. Dutt (*M.*) and Shri P. Guha (*M.*).

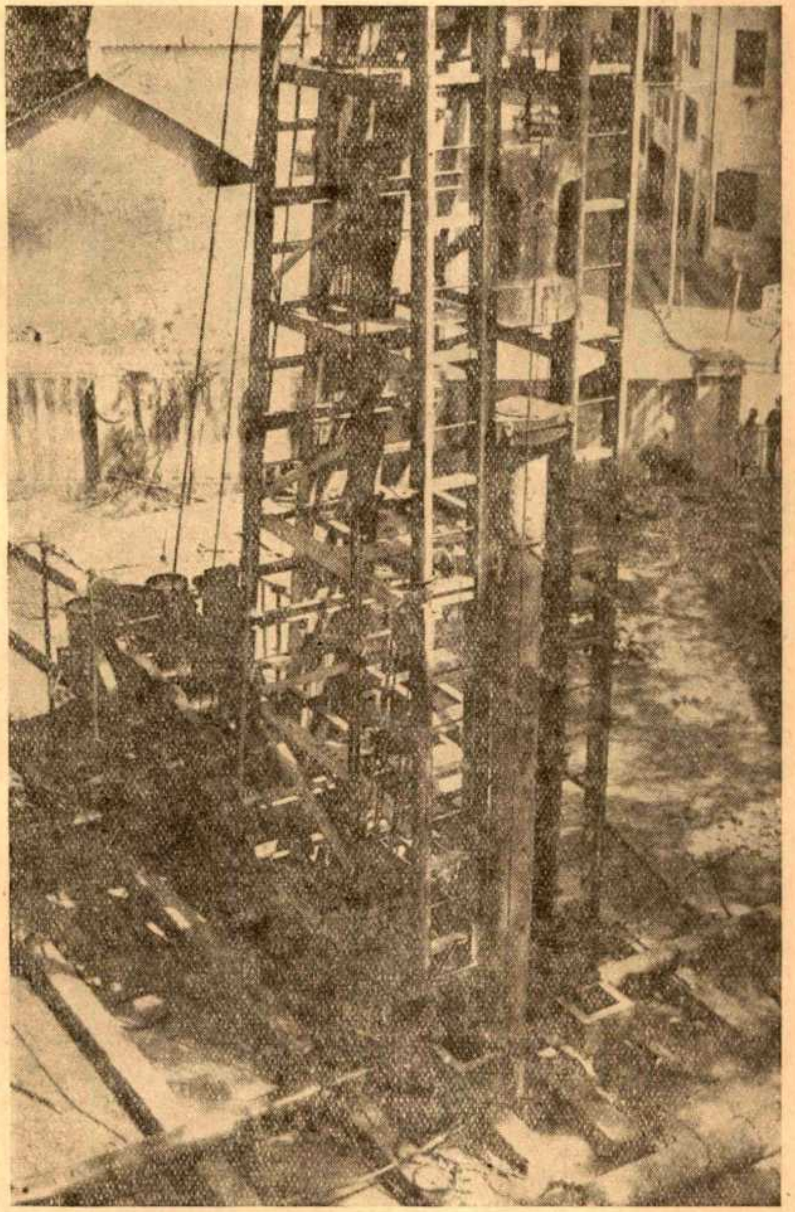
To bring this home into a reality, it has now become necessary for the Institution to engage itself in a major fund-raising venture. The project represents a considerable investment in money and materials. The Institution alone cannot do much to help itself unless its economy regains steam through massive support from the Government, the industries and members. The need for this has never been more urgent, but the will to meet the challenge has rarely been stronger. There is still a long way to go ; this perforce is a cooperative endeavour—it compels a pledge to contribute from both within and without the sphere of Institution's influence.



The first pile in hoist, kept in readiness for the drive. In the centre of the picture, with his back to the camera is Shri Akshoy Bose

The building can take shape if every member, unified as a whole, makes an individuals gift—to support this significant project which symbolizes the strength and unity of the profession, and stands as a source of pride to those who have helped to build it.

With this note and appeal, the Institution through its Headquarters Building Committee solicits your help and welcomes any financial contribution from you to this Bulding Fund. **YOUR CONTRIBUTION WILL BE GRATEFULLY RECEIVED.**



The 2½-ton drop hammer in action—the pile is in

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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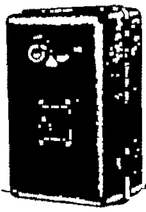

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P. N. Srivastava
H. G. Verma

Roorkee Sub-Centre

Chairman
G. Pande

Honorary Secretary
S. C. Dikshit

Members of Committee

G. K. Arora
S. C. Dikshit
Dinesh Mohan
S. N. Gupta
Dr. Jai Krishna
Dr. O. P. Jain
Col. Naresh Prasad
Prof. S. R. Singh

PROCEEDINGS OF THE FORTY-FOURTH ANNUAL CONVENTION HYDERABAD, FEBRUARY 8-13, 1964

The Annual General Meeting

Business Session, Saturday, February 8, 1964

The Forty-Fourth Annual General Meeting was held in the Jubilee Hall, Hyderabad, on Saturday, February 8, 1964, at 3.00 p.m.

Eighty-eight Corporate Members attended the Meeting, and it was presided over by the President, Dr. T. Sen.

1. After welcoming the delegates to the 44th Annual General Meeting, the President took up the minutes of the 43rd Annual General Meeting, circulated to all members of the Institution in the July 1963 issue of the *Bulletin*, for confirmation.

The President put the minutes to the house. Shri J. Datt (*Member*) proposed that the minutes be confirmed. Brig. P. R. Kumar (*Member*) seconded the proposal. It was carried unanimously.

2. The President next took up the Annual Report of the Council, printed in abstract in the October 1963 issue of the *Bulletin*, and the Audited Accounts for the year ended August 31, 1963, and asked if members had any comments to make.

Shri K. C. Banerjee (*Member*) said that the Audited Accounts had not accompanied the Notice of the 44th Annual General Meeting, and could not, therefore, be taken up at the Meeting for consideration.

The President said that he would like to inform the house that owing to the severe communal disturbances in Calcutta during the second week of January 1964, it had not been possible for the Headquarters to attach the Audited Accounts with the Notice of the 44th Annual General Meeting. He said he had, therefore, instructed the Headquarters to post the Notice of the Meeting in time, and follow it up with the Audited Accounts as soon as the disturbed circumstances permitted the Press to complete the work. He, therefore, invited the house to take up the Audited Accounts for consideration.

The house approved of the President's action. Shri M. Ganapati (*Member*) thereupon proposed that the Annual Report be adopted and the Audited Accounts be approved. Shri J. G. Bodhe (*Member*) seconded the proposal. It was carried unanimously.

3. The President then asked the Secretary to read the report of the Council on the elections for the session 1964-65 of the President and the Council. The Secretary, Shri B. Seshadri, announced as follows:

(i) Dr. T. Sen had been elected unanimously by the Council for a second term of office as President for the session 1964-65. (*Applause*); and

(ii) The following members by virtue of their having been elected Chairmen of Local Centres become members of the Council under Bye-law 44:

Andhra Pradesh Centre	Brig. M. K. Rao
Assam Centre	K. Mazumdar

Bengal Centre	S. K. Laha
Bihar Centre	S. N. Sinha
Bombay Centre	K. C. Pandya
Delhi Centre	D. C. Baijal
Gujarat Centre	M. M. Patel
Kerala Centre	V. Ranganathan
Madhya Pradesh Centre	Prof. V. V. Sarwate
Madras Centre	J. G. Abraham
Mysore Centre	B. R. Manickam
Nagpur Centre	R. S. Mehta
Orissa Centre	S. S. Behera
Poona Centre	Col. G. S. Viswanath
Punjab Centre	T. S. Randhawa
Rajasthan Centre	B. D. Mathur
Uttar Pradesh Centre	K. N. Misra

(iii) The following members by virtue of their having been elected from the Divisions become members of the Council under Bye-law 44 :

Civil Engineering Division ..	M. Ganapati Prof. N. S. Govinda Rao R. N. Joshi
Electrical Engineering Division ..	Prof. M. V. Deshpande S. S. Kumar A. R. Narayana Rao
Mechanical Engineering Division ..	M. Ganapati T. R. Gupta Maj.-Gen. S. P. Vohra
Chemical Engineering Division ..	Dr. V. M. Dokras Dr. A. Lahiri
Electronics and Telecommunication Engineering Division ..	Prof. S. P. Chakravarti Dr. A. K. Chatterjee
Mining and Metallurgy Division ..	Dr. G. P. Chatterjee Dr. J. W. Whitaker
Public Health Engineering Division ..	R. S. Mehta O. T. Raghavan

(iv) The following members by virtue of their having been elected from the Local Centres become members of the Council under Bye-law 44 :

Andhra Pradesh Centre	G. A. Narasimha Rao
Assam Centre	G. C. Goswami
Bihar Centre	K. N. Rohatgi
Bombay Centre	J. G. Bodhe B. P. Kapadia
Delhi Centre	Maj.-Gen. R. A. Loomba Maj.-Gen. S. P. Vohra
Gujarat Centre	P. J. Madan
Kerala Centre	P. C. Eapen
Madhya Pradesh Centre	Prof. A. Lakashmanaswamy
Madras Centre	Prof. S. Panchanathan
Mysore Centre	R. A. Rajagopal
Nagpur Centre	D. G. Tamaskar
Orissa Centre	S. Padhi
Poona Centre	B. V. Raman
Punjab Centre	D. C. Sharma
Rajasthan Centre	B. D. Mathur
Uttar Pradesh Centre	K. N. Misra

The President then informed the house that at the 431st meeting of the Council which had been concluded just prior to the Business Session, the Council had decided to invalidate the elections to the Council from the Bengal Centre owing to some irregularities, and had resolved that fresh elections should be conducted at the Bengal Centre and completed not later than 30th April, 1964.

He also informed the house that the elections of the Chairman of and to the Council from the Jammu and Kashmir Centre had not been held owing to disturbed local conditions, and that the Council had condoned this action at the same meeting and resolved that the Jammu and Kashmir Centre should conduct the elections so as to complete them not later than 30th April, 1964.

The above actions of the Council were approved by the house.

The President then informed the house that Shri M. Ganapati (*Member*) had been elected to the Council from both the Civil Engineering and Mechanical Engineering Divisions, and that Shri Ganapati had indicated his desire to him that he would like to give up his seat from one of those Divisions. The President asked the house how they would like the vacant seat to be filled.

After discussion, the house unanimously authorized the President to fill the vacancy by co-opting a member of his choice.

4. Shri D. P. R. Cassad (*Member*) proposed that Messrs. Price, Waterhouse, Peat & Co. be reappointed Auditors of the Institution for the year 1963-64 on a remuneration of Rs. 6,000 per annum. This was seconded by Shri T. R. Mehandru (*Member*), and it was carried unanimously.

With a vote of thanks to the Chair, the Session terminated at 3.45 p.m.

Inaugural Session, Sunday, February 9, 1964

The Inaugural Session was held in Ravindra Bharathi, Hyderabad, on Sunday, February 9, 1964, at 9.00 a.m. Over 1,200 members and guests attended the Session.

Dr. K. L. Rao, Union Minister of Irrigation and Power, inaugurated the Session. He arrived at Ravindra Bharathi at 8.50 a.m. Shri N. Sanjiva Reddy, Chief Minister of Andhra Pradesh, also arrived at the same time. They were received by Shri A. C. Subba Reddy, Minister for Public Works of Andhra Pradesh and Chairman of the Reception Committee of the Andhra Pradesh Centre, Dr. T. Sen, President, and Brig. M. K. Rao, Chairman of the Andhra Pradesh Centre, and introduced to the Past-Presidents and members of the Council for 1963-64.

This was followed by a group photograph.

Messages for a successful Convention were received from the following :

The President of India ; the Vice-President of India ; the Prime Minister of India ; the Governor of Andhra Pradesh ; the Governor of Gujarat ; the Governor of Madras ; the Governor of Maharashtra ; the Governor of Uttar Pradesh ; the Sadar-i-Riyasat of Jammu and Kashmir ; the Union Minister of International Trade ; the Union Minister of Steel, Mines and Heavy Engineering ; the Chief Minister of Andhra Pradesh ; the Minister for Education of Andhra Pradesh ; The Institution of Engineers (Ceylon) ; The South African Institution of Civil Engineers ; The South African Institution of Mechanical Engineers ; Société des Ingénieurs Civils de France ; and Société Royale Belge des Ingénieurs et des Industriels.

1. Shri Banarsilal Gupta, Mayor of Hyderabad, welcomed the delegates to the city of Hyderabad as follows :

'Hon'ble Chief Minister, Hon'ble Dr. Rao, Hon'ble Minister Shri Subba Reddy, Chairman of the Institution of Engineers (India), Andhra Pradesh Centre, and Friends,

I am grateful to Brig. Rao, and to the Andhra Pradesh Centre of the Institution of Engineers (India) for the privilege they have given me to associate myself with this Annual Convention of the Institution. On behalf of the city, I have great pleasure in extending a hearty welcome to you all and hope you will find the atmosphere of this place congenial for holding your deliberations. This Convention will also give a good opportunity to our people to get to know some of the foremost engineers of our country and to benefit from their discussions.

We are all aware that the engineering profession has to play a very important role in the development and progress of our country. What the engineers have done and achieved for the country during the past 15 years since independence is a matter of great pride and satisfaction for the people and for the engineers themselves. But a lot has still to be done and in the race for industrial development—which is the key to the country's economic freedom—we are still lagging far behind. It is true that advanced countries of the world like the U.S.A. or Britain have taken years or even centuries to go through the industrial revolution and that we, having remained under foreign bondage for centuries, have no miraculous means of compressing this slow and lengthy process into a few years or even a couple of Plan periods. But we are faced with the great challenge of the Nuclear Age when almost every morning brings news of fresh achievements in the fields of science and man's struggle to master the elements. We cannot afford to spend too much time on learning the basic lessons of science and technology. If the political freedom we have won recently is not to be lost to the dragon of economic proverty, we must try to bring about the industrial revolution in our country, through democratic institutions, in as short a period as possible. Otherwise, we will be permanently left behind and the freedom we have won will remain without shape and substance. The responsibility for giving real content to our freedom, therefore, lies on our engineers and technicians, and the time factor—the ability to create or make a thing in as short a time as possible—is, therefore, the most important attribute of a good engineer or technician from the national point of view. Its importance lies not only in cutting short our race for development but it would also reduce national waste of productive time.

But, in our race for industrial development, we have also to guard against falling into the pitfalls of extravagance and neglect of values which will result in such a loss of national resources that our race against time will become purposeless. It is, therefore, equally essential that a good engineer should not only achieve results in the shortest possible time but should also create at least possible cost and in the best possible way. To achieve things in a short time, with no consideration for cost is ordinary and does not deserve any credit. To do it with least possible expenditure—and thereby conserving what is required by another engineer engaged in making similar contribution to national development—is great and deserves all acclaim. By conserving and utilizing only that which you absolutely need, you not only avoid waste and save for other useful and productive activity but also, by leaving these resources for your other colleagues, make the flowering and utilization of their productive capacities and talent possible. In a poor country with hard earned and limited resources, the question of economy in development works has great importance and should be given our fullest consideration.

Having economized both in time and money, a good engineer may still waste his efforts by not devoting attention to the quality of thing made or produced. To make a shoddy thing in a short time at cheap cost is easy. To do it in the best way within the same time and cost, is the work of an engineer and creator. A good engineer, therefore, must pay full attention to the quality of his work and on no account should barter it away for anything. The conscience of an engineer should be like the conscience of an artist or a devotee. To establish a record in time and cost at the expense of quality would not only be against the conscience of a good engineer but would also result in a still greater national loss of time, money and energies having been directed towards the making or production of something which would have had the engineer bestowed greater attention towards its quality. Time, cost and quality are, therefore, the three important constituents of engineering. I have referred to these from the points of view of an ordinary citizen, the consumer, the taxpayer, the man who is eagerly waiting to possess the fruits of his freedom. To deprive him of his time and money and leave a shadow of a thing in his hands would not only be a crime against the nation, but would sow such seeds of frustration that the existence of our very democratic institutions would be in danger. In course of time, a major part of the economic activity of the country will go into the hands of engineers. The integrity with which that trust is honoured will bear far-reaching influence on strengthening the faith of our people in our democratic institutions. A great and heavy responsibility, therefore, lies on your shoulders. Given proper and stable political leadership—as we have in our own State under our beloved Chief Minister, Shri Sanjeeva Reddy, who is present here this morning—our engineers can discharge this responsibility to the best interests of the country.

With these words I thank Brig. Rao and the Institution of Engineers (India) once again for the opportunity given to me to speak to you. I wish you all success in your deliberations. I hope your Convention will make important contributions towards dissemination of useful knowledge and information. I hope all of you will enjoy your stay in our modest, cosmopolitan city. I hope you will come here again. If you do, we will be happy to welcome you once again.'

2. Shri A. C. Subba Reddy, Chairman of the Reception Committee, then welcomed the delegates to the Convention in the following words :

'Dr. K. L. Rao, Dr. Sen, Brig. Rao, Beloved Chief Minister, Ladies and Gentlemen,

It gives me great pleasure to welcome you all to the 44th Annual Convention of the Institution of Engineers (India) which is being held in Hyderabad, the capital of Andhra Pradesh.

Andhra Pradesh is the second largest State in India having an area of 106,041 square miles supporting a population of 3½ crores. Our economy is primarily based on agriculture. Sir Arthur Cotton's bold experiments in the last century across the Krishna and the Godavari are classic examples of how the artificial application of water to land can transform the country from a famine stricken area to the richest delta in the country. Nizamsagar across the Manjira is another scheme taken up in the thirties of this century which has benefited the Nizamabad District. The three rivers that traverse the State, *viz.*, Godavari, Krishna and Pennar, carry large volumes of water and their integrated development both for power generation and irrigation for the benefit of the country as a whole is a vital necessity and we assure our cooperation in this task.

As the Minister-in-charge of Public Works, I am conscious of the part that engineers have to play in carrying out the many development schemes drawn up. I hope and believe that by the deliberations of this august body the country will stand to gain.

Andhra Pradesh is also rich in coal deposits and its exploration for power production will strengthen the economy of the southern zone and provide industrial employment to the surplus agricultural labour. Rural electrification will also increase the amenities in the villages and reduce the migration to urban areas.

The 44th Annual Convention of the Institution will also be remembered apart from other things on account of the conferment of Honorary Life Membership of the Institution on Dr. K. L. Rao, one of our eminent engineers.

Dr. K. L. Rao was associated with the Mettur project in the thirties of this century, and thereafter he was on the staff of the Engineering College, Guindy, before going to England for further studies. On return, he was responsible for finalizing the design of the Ramapadasagar project across the Godavari, and the Nagarjunasagar dam. As a Member of C.W. & P.C., his talent was made available for the whole country. On retirement as C.W. & P.C. Member, he was elected to Parliament from Vijayawada constituency and later became Minister for Irrigation and Power in the Centre. By honouring him by conferment of Honorary Life Membership, the Institution is honouring itself. He will also deliver during this session the Dr. M. Visvesvaraya Memorial Lecture.

I hope you will all enjoy your stay in Hyderabad. Visits have also been arranged to various important projects in the State. We have tried our best to make your stay here as comfortable as possible, but if there are any shortcomings, please bear with us.

I extend to you all once again a very hearty welcome.

3. Dr. T. Sen, President, then announced the award of the following prizes by the Council and the Trustees of the Public Charitable Trust for the Advancement of Engineering Education respectively:

The Council of the Institution have awarded the following prizes for the year:

1. The President of India's Prize for the best paper in Hindi to Shri Vishwambhar Prasad (*A.M.*) for his paper 'Valuation of Immovable Properties'.
2. The Union Ministry of Irrigation and Power Gold Medal and Cash Award for the best paper on civil engineering aspects of river valley development to Shri N. S. Iyengar (*M.*) for his paper 'Role of Reservoirs in the Solution of Flood Problems'.

(3) The Union Ministry of Irrigation and Power Gold Medal and Cash Award for the best paper on power development and utilization to Sarvashri S. S. Kumar (*M.*) and S. Rammohan (*M.*) for their joint paper 'Power Development in the Eastern Zone'.

(4) An Institution Prize to Dr. R. Narayanaswamy (*A.M.*) for his papers 'Behaviour and Ultimate Strength of Prestressed Concrete Hollow Beams in Bending' and 'Strength of Prestressed Concrete Beams under Combined Bending and Torsion'.

(5) An Institution Prize to Dr. H. R. Chablani (*A.M.*) for his paper 'Predetermination of Electrical Characteristics of Steel Tubes at Power Frequencies: Parts 1 and 2'.

The Trustees of the Public Charitable Trust for the Advancement of Engineering Education have awarded the following prize :

(6) The Shrimati Saroma Sanyal Memorial Prize to Shri B. P. Agrawal for having secured the highest number of marks in the subject of Water Supply and Sanitary Engineering in passing Section B of the Associate Membership Examination.

For the papers read at the Students' Session held on 8th February, 1964, the following prizes have been awarded :

(1) Prize for the best paper to Shri B. Nagaraja Rao (*Student*) for his paper 'Lasers'.

(2) Three other prizes to :
  (i) Shri P. N. Shetty (*Student*) for his paper 'Emergency Releases of Master Controller Handle and Flat Wheels in an Electric Train' ;
  (ii) Shri G. G. Kelkar (*Student*) for his paper 'Effect of Cement on Quality of Coarse Aggregate to Fill a Specified Volume of Concrete' ; and
  (iii) Shri P. G. K. Murthy (*Student*) for his paper 'Valve Setting in Locomotives'.

As the prizes were announced by the President, the presentations were made by Dr. Rao to the recipients who were present. They were Sarvashri Vishwambhar Prasad, N. S. Iyengar, S. S. Kumar and S. Rammohan, Dr. H. R. Chablani, Sarvashri B. Nagaraja Rao, P. N. Shetty, G. G. Kelkar and P. G. K. Murthy.

4. Dr. Sen then conferred the Honorary Life Membership of the Institution on Dr. K. L. Rao, and called upon the Secretary, Shri B. Seshadri, to read the citation for Dr. Rao. Shri Seshadri read the citation as follows :

'Dr. Kanuru Lakshman Rao pioneered engineering research in the Madras University and was the first engineer to receive the post-graduate degree of Master of Engineering from that University. Later, he obtained the Ph.D. degree in Engineering from the University of Birmingham through his researches on concrete structures.

He served on the teaching staff of the Engineering College, Loughborough, in the United Kingdom, in 1943-45. After returning to India, he served with the Government of Madras, before joining the Central Water and Power Commission, Government of India, in 1951.

In 1954, he was appointed as Chief Engineer (Planning and Designs) in the Commission. Two years later, in 1956, he became Member (Designs and Research). He retired from service in 1961.

Dr. Rao's name has become synonymous with the design of dams in the country. He was responsible for the designs of many of the more important dams, among which should be mentioned Hirakud, Chambal, Lower Bhavani, Kosi, Malampuzha and Nagarjunasagar. His designs were marked, besides their high technical excellence, by the economies they led to in construction, and thus contributed directly to the signal success of these projects.

Dr. Rao's contributions to the technical press are legion. He received from the Institution of Engineers (India) the Governor-General's Prize for 1947-48 for the best paper contributed to its *Journal*, the same Prize, designated the President of India's Prize, a second time in 1953-54, and the Prize again for a third time in 1957-58, a unique record. He is the author of a widely known standard work on concrete published by Pitmans of London.

Dr. Rao was the Chairman of the Civil Engineering Section of the Institution of Engineers (India) from 1957 to 1959. He is a Vice-President of the International Conference on Soil Mechanics and Foundation Engineering since 1957 and was Chairman of the Indian Society of Soil Mechanics and Foundation Engineering from 1958 to 1960. He was twice President of the Institution of Engineers (India) in 1958-59 and 1959-60. He was also President of the Central Board of Irrigation and Power for 1960.

Dr. Rao has travelled extensively in the world and visited dams and river structures in the United Kingdom, the European Continent, the United States, the U.S.S.R., Egypt, Japan and China, and is a familiar figure to distinguished engineers in this field of those countries. His reports and analyses of these structures have contributed greatly to the design of similiar structures in this country.

The degree of Doctor of Engineering (Honorary) was conferred on Dr. Rao by the Andhra University in 1960. In 1963, Dr. Rao received the Padma Bhushan.

On his retirement from service in 1961, Dr. Rao was elected a Member of Parliament from the Vijayawada constituency in Andhra Pradesh. This was hailed as a significant event by the engineering profession, but still greater was to come. On 20th July, 1963, he was appointed Union Minister of Irrigation and Power, the first engineer in India to achieve this high distinction.'

Dr. Sen thereupon presented the Scroll of Honorary Life Member to Dr. Rao. Dr. Rao signed the Register of Honorary Life Members. (*Applause*)

5. Maj-Gen. Harkirat Singh, Immediate Past-President, next introduced Dr. T. Sen, President-Elect for 1963-64, in the following terms :

'I had the pleasure of introducing Dr. Sen at the 43rd Annual Convention in Bangalore. I am to have that pleasure again now, as Dr. Sen has been re-elected for another term as President. I shall, therefore, say a few words, addressed mainly to such of you who were not present at the Bangalore Convention.

Dr. Sen has had a very chequered career. He did considerable post-graduate research work in Germany in fluid mechanics and hydraulic machinery, which led to the award of a Doctorate in Mechanical Engineering.

Dr. Sen returned from Europe in 1932. In the same year he was arrested under Bengal Ordinance and put in a detention camp. There is no need to remind you that those years were a period of intense political activity in the country. After a year, Dr. Sen was externed from the then Presidency of Bengal and lived away from his home till 1939 when the ban was lifted.

Dr. Sen returned to Calcutta to the then College of Engineering and Technology, Jadavpur. He later became Principal of the College, and in 1956, when the Jadavpur University was established, he was appointed its first Vice-Chancellor.

In 1957, Dr. Sen went to Europe and North America to study the educational systems in the different countries. He interspersed these educational and academic activities with two terms as Mayor of Calcutta in 1958 and 1959, no mean achievement.

In 1959, he visited Germany to study, in particular, university administration. In the following year, he visited France to study the educational system in the higher secondary schools in that country. Last year, in 1963, he attended the Commonwealth Universities Congress in London, and played an important part in its deliberations.

Dr. Sen is connected with a large number of educational institutions in this country and the list is really too long to mention. I will just mention one or two of them., He is a Member of the Indian National Commission for Cooperation with UNESCO. He is the President of the Executive Council of the Inter-University Board of India. He is a Member of the Executive Council of the Indian Science Congress Association. And so on. He was also President of the Association of Principals of Technical Institutions (India) in 1961 and 1962. Dr. Sen is also a Director of a number of public and private companies, and his cultural associations are again too long to recite here.

Dr. Sen was member of the Institution Council for many years before he became President last year. You know of his leadership during the session which has just ended. I have now much pleasure in installing Dr. Triguna Sen as President of the Institution for 1963-64.'

Maj.-Gen. Harkirat Singh then installed Dr. Sen as President for 1963-64. (*Applause*)

6. Dr. Sen then delivered the Presidential Address (see pages 37 to 42).

7. Dr. K. L. Rao, Union Minister of Irrigation and Power, next delivered the Inaugural Address.

'Dr. Sen, Hon'ble Chief Minister Shri Sanjiva Reddy, Hon'ble Minister Shri Subba Reddy and friends,

I wish to convey my grateful thanks to Dr. Sen and the Council for doing me the double honour today of conferring on me the Honorary Life Membership of the Institution and inviting me as the Chief Guest at this Inaugural Session.

We are now living in times of deep upheavals in all branches of engineering. The importance of this Institution was never so great as it is in the present time. Let me recall the two main objects of this Institution : the first one is to promote technical and technological knowledge with a view to disseminating the same amongst its members for the technical and scientific advancement of the country, and the second one is to maintain high standards in engineering practice.

The population of the country is increasing day-by-day but there is no proportionate increase in the field of its activities not excluding engineering. The population is increasing at the rate of one lakh per day. It is not only necessary to feed and clothe this increasing population, but it should also acquire more knowledge to catch up with the current times. Obviously, people ask for better living conditions, and for this reason, there should be greater development of the resources of the country. It is the duty of the engineer to look after these requirements.

The engineer cannot be effective unless he participates in the management of the requirements of the population, He has to equip himself and participate in organizations which manage national affairs. In this connection, I wish to read the valuable opinion of my colleague in the Cabinet, Shri C. Subramaniam, who inaugurated the Annual General Meeting of the Delhi Centre last month. He said 'If you want to bring about changes in the future development of the country only scientists and engineers can accomplish the task. That is why in the modern society an engineer has to occupy an important place.' Therefore, it is necessary for us to realize our responsibilities to the coming generations of India. It is here that the Institution can play an important role. I appreciate the President for his frank and critical approach to the problems facing the Institution at the moment. His proposals in respect of conducting part-time classes, and refresher courses for engineers and establishing book-banks, etc., are indeed very good. Now there is one fact to be borne in mind ; pleading in my own way, it is necessary that whenever a controversy arises, engineers should discuss and arrive at a decision and advise the people in the proper way—by people mean those who are conducting the affairs of the nation, that is, the Government.

Unlike in other European countries where they have separate institutions for the various branches of engineering, we in India have a single institution which provides an umbrella for all branches of engineering. I had an occasion to meet the members of several institutions in European countries. Their desire, as I learnt, was to have one institution which embraces all branches of engineering. Therefore, I feel that the present character of our Institution should continue. I am very glad Dr Sen spoke about the growth of the different branches of engineering with equal dignity. Being a united body which embraces all the branches of engineering, the Institution can play a greater part in the nation's affairs. In this connection, Dr. Sen has correctly stated that in the Fourth Plan the engineer can play a major part. That is true. The nation must develop equally. It would not be good for one State to develop well and another to lag behind.

In India, we need more engineers. The United States of America produces 30,000 engineering graduates a year whereas we produce 9,000 only. If we calculate the output per million of people, our figure will be much less than one-third of what the U.S.A. produces. There is no use in producing a large number of engineers, it is their quality that is most important. It is essential for the present day engineers to have a capacity for thorough understanding. To recount some of my personal experiences : when I was studying in the Engineering College, Guindy, we had on the staff Prof. Dey, who had been to the U.K. for advanced studies. He was teaching the subject 'Corrosion Effect on Iron'. In the final stages of the course it was found that none of the students had understood the subject. Even now I do not know what was taught. There is another incident which I remember. While I was in the U.K. as a teacher, it happened that most of my students secured first classes and the management of the Loughborough College thought that I was responsible for this good result and hence I should be congratulated. I was called by the Principal and told that although the results were good, the students had produced similar answers and my teaching was therefore not satisfactory. Nowadays, students are given the question papers of the last 10 years examinations to study. The same questions will be usually repeated. The students cram the answers and fare well in the examinations. But in the U.K. and other countries, the examinations are conducted in a different way. They only test whether a student has understood the subject. Understanding of a subject has importance in later life. It is essential that the Institution should also conduct the examinations in a better way. I suggest that the Institution should make a discriminating review of the engineering education in the country and recommend to the Government ways and means of improving teaching methods. I am sure the Government will be happy to have such a report. There is another aspect of the engineering profession in this country—that of specialization. In this respect, we are very backward. For example, consider the designing of a power house and its construction. As far as the civil engineering part is concerned, the work involved is only to investigate the soil and make the structural designs. We are at present spending lakhs of rupees on designing jobs. We have been wasting like this. For instance, if we want to increase the power capacity, we have to spend crores of rupees to obtain foreign designs of power stations. These problems are a challenge to the engineers in the country. We are hard-pressed for foreign exchange. If we can design ourselves, we can save the valuable natural resources for our country. I, therefore, suggest that the Institution should take greater responsibility in achieving this aspect. There is something wrong with the engineering education in our country. This must be studied soon and remedial action taken.

It is not the construction or design that counts but what counts is whether we are able to do these jobs ourselves. If we have to depend on other countries, it means we are failing in our duty. The Institution must pay special attention to find out the fields in which engineering specialization is required and submit a report to the Government.

There is again the difficulty of getting the equipments we need. For this purpose, the Ministry of Irrigation and Power, Government of India, has formed a committee to assess what amount of specialization we have to achieve and what are the fields to derive this from. By the end of the Fourth Plan, we hope we will be self-sufficient in this direction. There is another aspect to which I draw your attention, *i.e.*, I am not talking much about self-sufficiency in food, clothing, power and so on; it is self-sufficiency in engineering skills that is fundamental. Again it is here that the Institution can play a very vital role.

I have now great pleasure in inaugurating the 44th Annual Convention and wish it all success'.

8. Brig. M. K. Rao, Chairman, Andhra Pradesh Centre, proposed a vote of thanks to the Chief Guest, Dr. Rao, the Chief Minister of Andhra Pradesh, Shri N. Sanjiva

Reddy, the Mayor of Hyderabad, Shri Banarsilal Gupta, and the other guests present as follows:

'I have a very pleasant duty to perform in proposing a vote of thanks.

This 44th Annual Convention was to have been held in Chandigarh. Due to some unforeseen reasons, it could not be held there. It was on October 20, 1963, at the Institution Council Meeting held at Calcutta, that Shri Dildar Husain had invited this Convention to our city of Hyderabad. On hearing the news on October 22, 1963 the majority of the members of the Local Committee had put their hands up and said that it would be almost impossible to arrange the 44th Convention with 15 weeks' notice.

We wanted to honour the pledge given by our Past-President at any cost. We marched ahead with determination. We hope that if there are any shortcomings you will excuse us.

An urgent appeal was made to our popular Chief Minister, the Ministers of P.W.D. and Finance, the Mayor, the Commissioner, military friends, friends from business concerns, and other citizens of Hyderabad. The response was instantaneous and in full measure. Wherever we approached, we have been given the fullest cooperation. One of our Past-Chairmen of Andhra Pradesh Centre, Shri R. M. Patri, agreed to serve as Honorary Secretary under the 'Kamaraj Plan.'

I thank the Worshipful Mayor Shri Banarsilal Gupta for participating in this function, for giving us words of wisdom, and for extending you a cordial welcome to the twin cities of Secunderabad and Hyderabad.

We are extremely grateful to Dr. K. L. Rao, the engineer-statesman—a stalwart in men and a giant amongst engineers—he is rightly the 'Engineer of the Year 1963-64'. He has been conducting the affairs of the country with extreme ability, thoroughness and efficiency that even in such a short period of six months, he has already made a tremendous impression in and outside Parliament. We are indeed very proud that this Convention has conferred on him the Honorary Life Membership of the Institution. On behalf of the Institution, I thank him most sincerely for his Inaugural Address. I pray to God to give him many more years of dedicated service to the country.

We are fortunate today that our patron and the Chief Minister, Shri N. Sanjiva Reddy, is able to be present here this morning. His very presence inspires us to great heights of human conduct, self-sacrifice and humble service. When we approached him for help, he had immediately responded with promptness and assured us that we could count on him at all times. On behalf of the Institution of Engineers (India), I thank him immensely.

Our Public Works Minister, Shri A. C. Subba Reddy, who had welcomed you as the Chairman of the Receiption Committee, is the kingpin for all our activities. He had been giving us all possible help whenever and wherever I approached him either in his office, at the airport, on the lawns of the Government House, or at marriage parties. He showed the greatest enthusiasm in mustering all the resources under him. Today, most of the Ministers of this State have gone to Coimbatore to attend the wedding of the son of one of them. Shri Subba Reddy had flatly refused to leave the post only to help us and to guide the affairs of the Convention. On behalf of the Institution, I thank him most sincerely for all that he has done and for his short but apt speech this morning.

We are grateful to Hon'ble Shri K. Brahmananda Reddy, Finance Minister, for giving us a donation and helping us in various other ways for the success of this Convention.

I thank Shri P. V. G. Raju, the Education Minister, Dr. M. Chenna Reddy, Minister for Planning, and Shri J. V. Narasinga Rao, Chairman, Andhra Pradesh State Electricity Board, for agreeing to be Vice-Chairmen of the Reception Committee. I thank the various companies and institutions for their generous contributions, advertisements, courtesy dinners, lunches, teas, etc.

I thank our President, Dr. Sen, all our Past-Presidents, members of the Committee of the Institution of Engineers, Andhra Pradesh Centre, the Honorary Secretary, Shri R. M. Patri, the Joint and Organizing Secretary, Maj. R. S. Attre, the Joint Secretaries, Dr. Purushotham and Dr. Asthana, Maj. Karai for his splendid work on the Souvenir, Col. C. S. Krishnamurty and officers of the Technical Services Group, Col. D. A. Mehta and his band of officers and men from the E.M.E. Centre, officers from the E.M.E. School, Shri S. G. K. Reddy, District Manager, Telephones, and all the ladies and gentlemen who have worked day and night for the last eight weeks with the sole object of bringing this function to a success. I thank every member of the staff down to the class IV employees of the Institution of Engineers, Andhra Pradesh Centre, and all the volunteers. Finally, Ladies and Gentlemen, I thank you very much in coming here this morning and participating in this pleasant function.'

The Session then concluded at 11.00 a.m. A Tea was given in honour of the Chief Guest in the grounds of Ravindra Bharathi.

Seventh Sir Mokshagundam Visvesvaraya Lecture

Dr. K. L. Rao, Union Minister of Irrigation and Power, then delivered the Seventh Sir M. Visvesvaraya Lecture at 11.30 a.m.*

Shri R. M. Patri, Honorary Secretary, Andhra Pradesh Centre, then proposed a vote of thanks to Dr. Rao in the following terms:

'I have now the very pleasant duty of extending our warmest thanks to Dr. Rao for delivering the Sir Mokshagundam Visvesvaraya Lecture on the occasion of this Annual Convention. The Lecture has maintained the high traditions set up to honour the most distinguished engineer India has perhaps ever produced. The invitation to Dr. Rao to deliver this Lecture was extended at a very late stage, primarily on account of the fact that the venue of the Annual Convention was changed from Chandigarh to Hyderabad. Nevertheless, Dr. Rao, with his usual generosity where matters of the Institution are concerned, accepted our invitation. The result has been what all of you, Ladies and Gentlemen, have just heard.

Dr. Rao has given us a learned discussion on the pattern of our engineering and technological development in the coming years. We could not have had a recital of our

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*The text of the Lecture will be printed in a subsequent issue of the *Bulletin*.

technological future from anyone superior. We have been given so many facts and figures, backed with sound reasonings as to why they should be so, that only a deep study of their portent will reveal the future to us as it has been revealed to Dr. Rao. I, for one, shall be looking forward with much impatience to reading the text of this Lecture in print, when only I think I will be in a position to wholly appreciate the magnitudes of the things he has said to us—and indeed revealed to us—this morning.

We in Andhra Pradesh are particularly delighted that the Sir M. Visvesvaraya Lecture on this occasion should have been delivered by Dr. Rao whom we consider so much as one of ourselves. Dr. Rao has raised the status of the engineering profession in this country to new heights—heights which were totally inconceivable only a few years ago. I need not remind you that he is the first engineer in this country to be given the grave charge of a Ministry of the Central Government.

I would now like to invite you all to join me and propose a very heartfelt vote of thanks to Dr. Rao for having delivered the Seventh Sir Mokshagundam Visvesvaraya Lecture.'

Dr. Rao thereupon suggested that a statue of Sir M. Visvesvaraya should be erected in the great city of Hyderabad with which he was so closely associated. He said he would like to donate the amount of the honorarium for delivering the Lecture for this purpose (*Applause*).

This was followed by announcements of other donations by the Past-Presidents, Dr. M. S. Thacker, Shri D. P. R. Cassad and Shri S. B. Joshi, and some of those present.

The National Anthem was then played, and Dr. Rao left the meeting at 12.30 p.m.

Closing Session, Tuesday, February 11, 1964

The Closing Session was held at 4.00 p.m. on February 11, 1964, in the Jubilee Hall, Hyderabad. The President, Dr. T. Sen, was in the Chair.

Commencing the proceedings, the President said that the Council had, at the meeting held that afternoon, approved of a proposal to amalgamate the Mysore Engineers' Association with the Institution. He briefly related the activities of the Mysore Engineers' Association and said that it had just completed one hundred years of existence. He said that he would, therefore, like to place the Council's recommendation before the meeting in order that a formal ceremony could be held in Bangalore in the month of May for the purpose of securing the amalgamation. This was very much desired by both the Executive Committee of the Mysore Engineers' Association and the Mysore Centre of the Institution. He then read out the terms of the amalgamation as agreed between the Council and the Executive Committee of the Mysore Engineers' Association :

(1) 'The present building of the Mysore Engineers' Association shall be transferred to and vested in The Institution of Engineers (India).

(2) The building shall be established as a centre for engineering research within The Institution of Engineers (India), in coordination with the Government of Mysore.

(3) No other assets of the Mysore Engineers' Association shall be taken over by the Institution.

(4) The present members of the Mysore Engineers' Association shall be admitted into the Institution in the appropriate classes of membership within one year of the date of amalgamation.

(5) Upon such admission, the entrance fee appropriate to the relevant class of membership shall be waived.

(6) Upon amalgamation, the subscription of members of the Mysore Engineers' Association admitted into the Institution shall be waived for a full year, that is, they shall pay no subscription for the Institution year 1964-65.

(7) Members thus admitted shall pay the annual subscriptions appropriate to the respective classes of membership thereafter.

(8) Three scholarships, each worth Rs. 900 per annum, shall be established in the name of the Mysore Engineers' Association for award to outstanding students studying in engineering colleges affiliated to the Mysore University. These scholarships shall be permanently established by the Institution in the Public Charitable Trust for the Advancement of Engineering Education, which is being operated by the Institution. The award of the scholarships shall be decided by the Mysore Centre, and the Mysore Centre shall frame rules for their award.

(9) A Lecture to be styled 'The Mysore Engineers' Association Centenary Lecture' shall be established by the Institution and delivered annually at the Mysore Centre by an eminent person. An honorarium of Rs. 1,000 shall be provided by the Institution for this purpose.

(10) All the present activities of the Mysore Engineers' Association consistent with the aims and objects of the Institution shall be continued, and the name of the Association and its past office bearers shall be suitably commemorated.

(11) The members of the present Executive Committee of the Mysore Engineers' Association shall be ex-officio members of the Committee of the Mysore Centre for one year from the date of amalgamation.'

The meeting unanimously approved of the amalgamation, and authorized that a formal ceremony may be held in the month of May to effect it.

At the request of the President, brief reports of the technical sessions held in the various Divisions and Groups were presented by the respective Chairmen.

(i) Dr. A. K. Chatterjee (*M.*), retiring Chairman of the Electronics and Telecommunication Engineering Division, spoke briefly on the formation of the Automatic Control Group in the previous year and the Conference which the Group had held in Sindri.

Dr. Chatterjee then said that the proceedings in his Division opened with the Chairman's Address. This was followed by paper meetings in which the papers scheduled for discussion were presented. The discussion was both good and informative.

Dr. Chatterjee said that the proceedings terminated with a talk by Prof. G. H. Felt, Guest Professor, Indian Institute of Technology, Kharagpur, under the USAID scheme.

(ii) Dr. V. M. Dokras (*M.*), retiring Chairman of the Chemical Engineering Division, said that the proceedings in his Division commenced with the Chairman's Address in which he reviewed the developments in chemical engineering in India and abroad during the previous year. This was followed by paper meetings where four papers were presented. The discussion which followed was informative and instructive.

(iii) The Secretary, Shri B. Seshadri, read a brief account of the proceedings in the Mechanical Engineering Division on behalf of Shri T. R. Gupta, retiring Chairman, who was unable to be present.

Out of the seven papers scheduled for discussion, only three were presented, as the authors of the remaining four papers were absent.

(iv) Prof. M. V. Deshpande (*M.*), retiring Chairman, Electrical Engineering Division, said that the proceedings in the Electrical Engineering Division started with the Address of the Chairman.

Nine papers were discussed in the paper meetings. Each paper was followed by substantial discussion.

(v) Shri R. S. Mehta (*M.*), retiring Chairman, Public Health Engineering Division, said that the activities in his Division since its formation had substantially increased. The Chairman in his Address reviewed these activities during the past year and the developments in the field of public health engineering in India and abroad, with particular emphasis on the problems of water supply and waste water treatment in India.

Four papers were presented, and the discussion on them was keen.

Two visiting Professors also gave talks. These were Prof. L. Mantilla, Environmental Health Regional Adviser, WHO, New Delhi, and Prof. G. A. Rohlich Professor of Sanitary Engineering, University of Wisconsin.

Shri Mehta added that for the first time a Brain Trust programme was arranged in the Division. Four senior public health engineers formed the Trust and members present were encouraged to ask questions on all matters connected with public health engineering. These were answered by the Trust, and the experiment was a success.

At the conclusion of the proceedings, the following resolutions were adopted by the Public Health Engineering Division for consideration of the Corporate Members.

1. *Resolved* that the Public Health Engineering Division notes with deep concern that the specialized branch of Public Health Engineering has been left out from the All-India Service of Engineers. It feels strongly that this would come in the way of attracting in sufficient numbers bright and capable engineers to this important field of engineering.

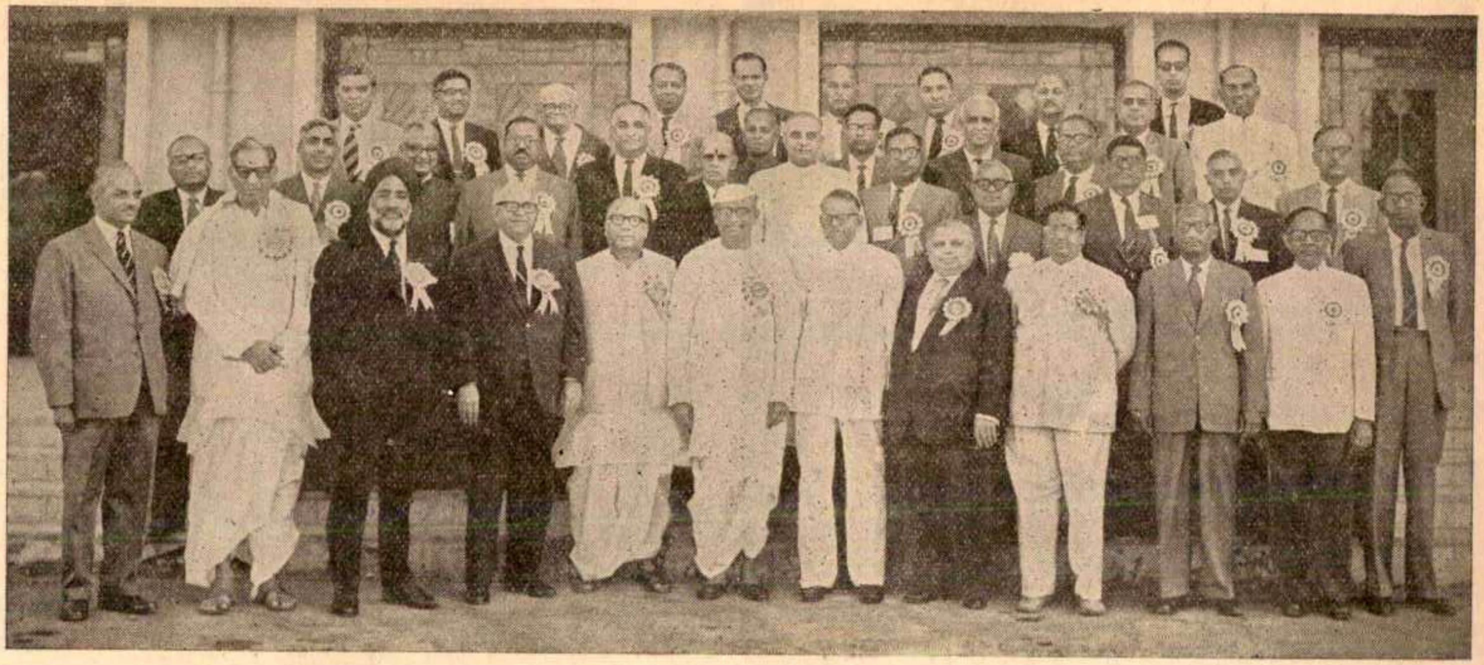
Referring to the Resolution passed in this behalf last year, the President be requested to take up this matter with the Government of India once again.

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964

Dr. T. Sen, President, and Dr. M. S. Thacker being Received by Brig. M. K. Rao, Chairman, Andhra Pradesh Centre, Dildar Husain (Past-President), Major R. S. Attre (Organising Secretary, 44th Annual Convention), and Others at Hyderabad Airport on Their Arrival

Dr. Sen Introducing Members of the Council to Dr. K. L. Rao, Chief Guest

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



THE COUNCIL 1963-64

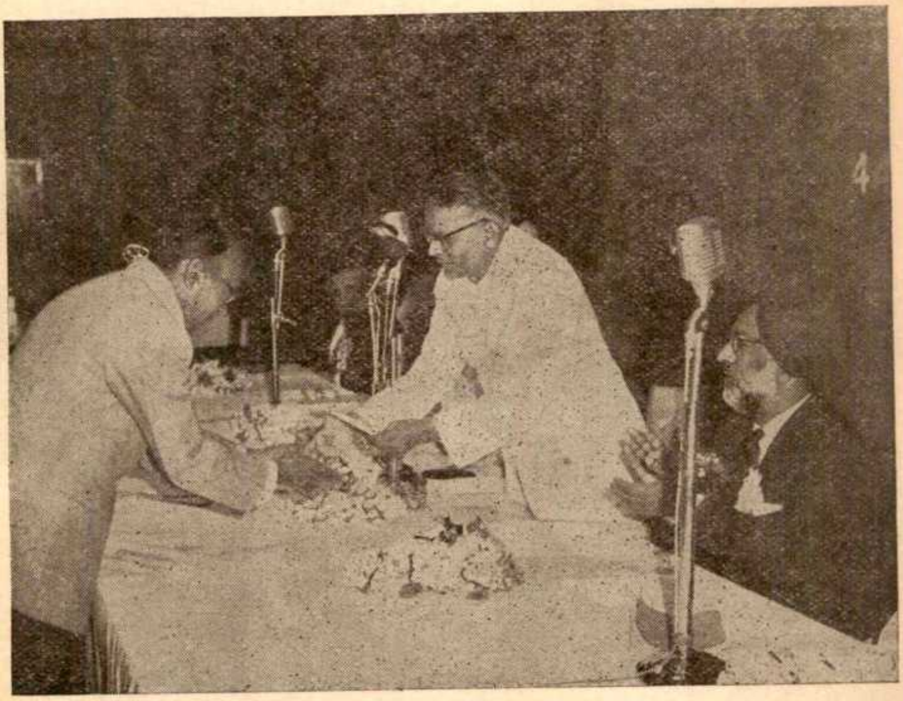
Standing : Front Row (L. to R.) Brig. M. K. Rao (*Chairman, Andhra Pradesh Centre*), A. C. Subba Reddy (*Minister for P.W.D., Andhra Pradesh*), Maj.-Gen. Harkirat Singh, Dr. M. S. Thacker, Dr. T. Sen (*President*), Dr. N. Sanjiva Reddy (*Chief Minister, Andhra Pradesh*), Dr. K. L. Rao (*Union Minister for Irrigation and Power, Chief Guest*), D. P. R. Cassad, Banarsilal Gupta (*Mayor of Hyderabad*), G. A. Narasimha Rao, V. Ranganathan, Prof. A. Lakshmanaswamy

Standing : Middle Row (L. to R.) S. N. Sinha, Prof. V. V. Sarwate, Prof. N. S. Govinda Rao, B. R. Manickam, Col. G. S. Viswanath, Dildar Husain, A. R. Narayana Rao, O. T. Raghavan, J. G. Bodhe, K. C. Pandya, D. C. Baijal, B. V. Raman

Standing : Last Row (L. to R.) S. K. Laha, M. Achyuta Rao (*non-Council Member*), B. P. Kapadia, Prof. M. V. Deshpande, D. G. Tamaskar, M. Ganapati, S. S. Kumar, Prof. S. Panchanathan, Maj.-Gen. S. P. Vohra, R. S. Mehta, Maj.-Gen. R. A. Loomba, M. M. Patel, P. J. Madan, B. Seshadri (*Secretary*), S. Padhi

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964

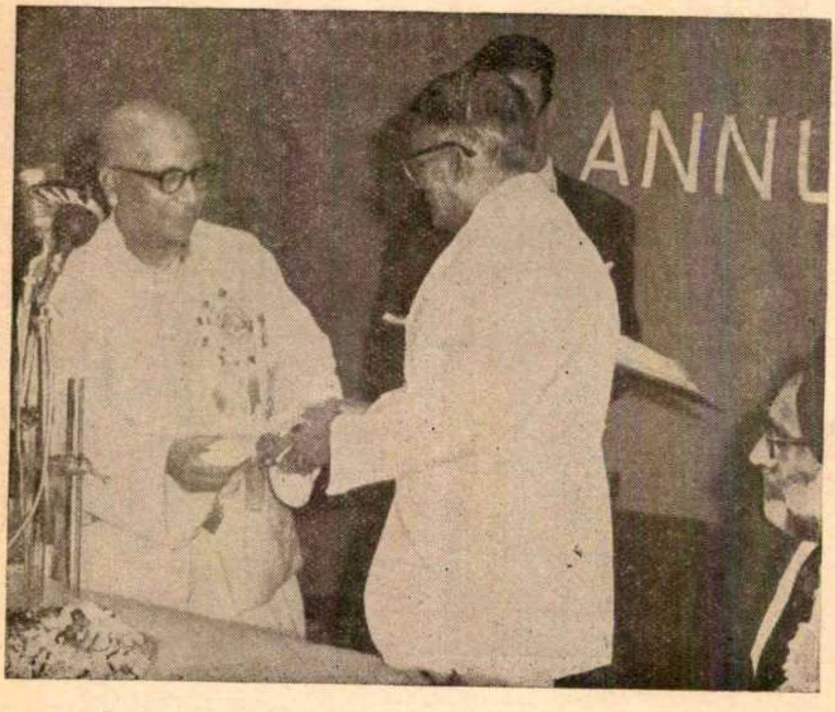
SHRI BANARSILAL GUPTA, MAYOR OF HYDERABAD, WELCOMING THE GATHERING



VISHWAMBHAR PRASAD (*A.M.*) RECEIVING THE PRESIDENT OF INDIA'S PRIZE FOR THE BEST PAPER IN HINDI

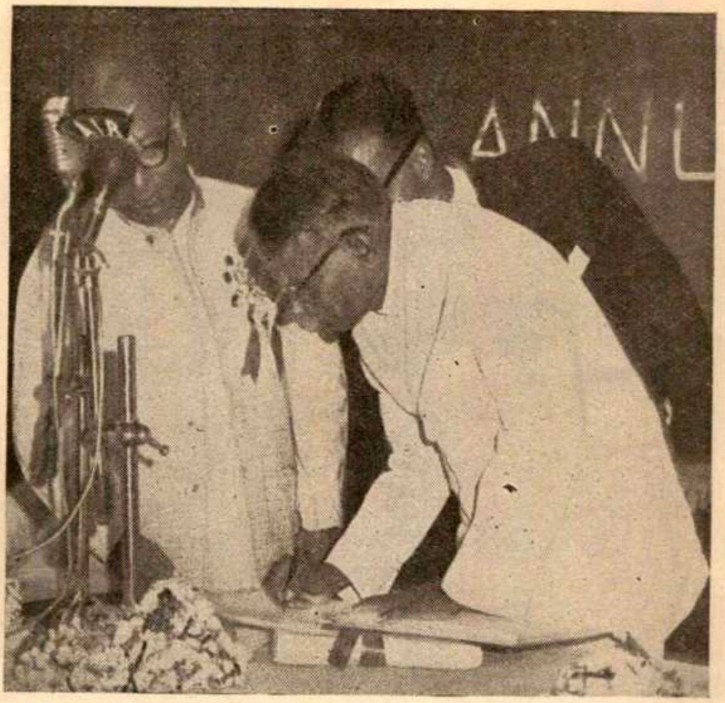
44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964

SHRI N. S. IYENGAR (*M.*) RECEIVING AN UNION MINISTRY OF IRRIGATION AND POWER GOLD MEDAL AND CASH AWARD FOR THE BEST PAPER ON CIVIL ENGINEERING ASPECTS OF RIVER VALLEY DEVELOPMENT FROM DR. RAO



DR. SEN PRESENTING THE SCROLL OF HONORARY LIFE MEMBER TO DR. RAO

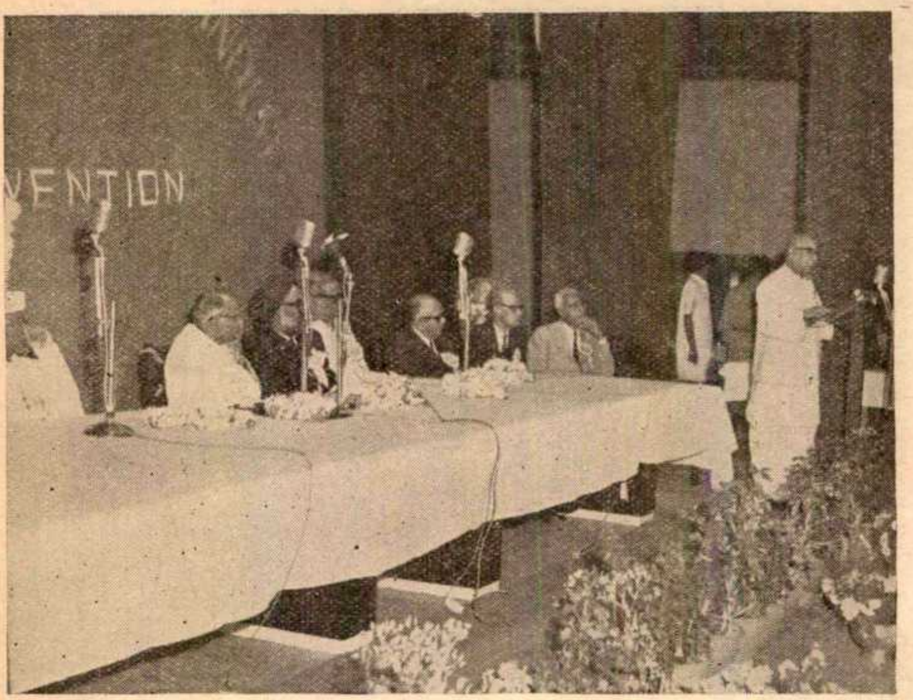
44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



DR. RAO SIGNING THE REGISTER OF HONORARY LIFE MEMBERS

MAJ.-GEN. HARKIRAT SINGH INTRODUCING DR. SEN TO THE GATHERING

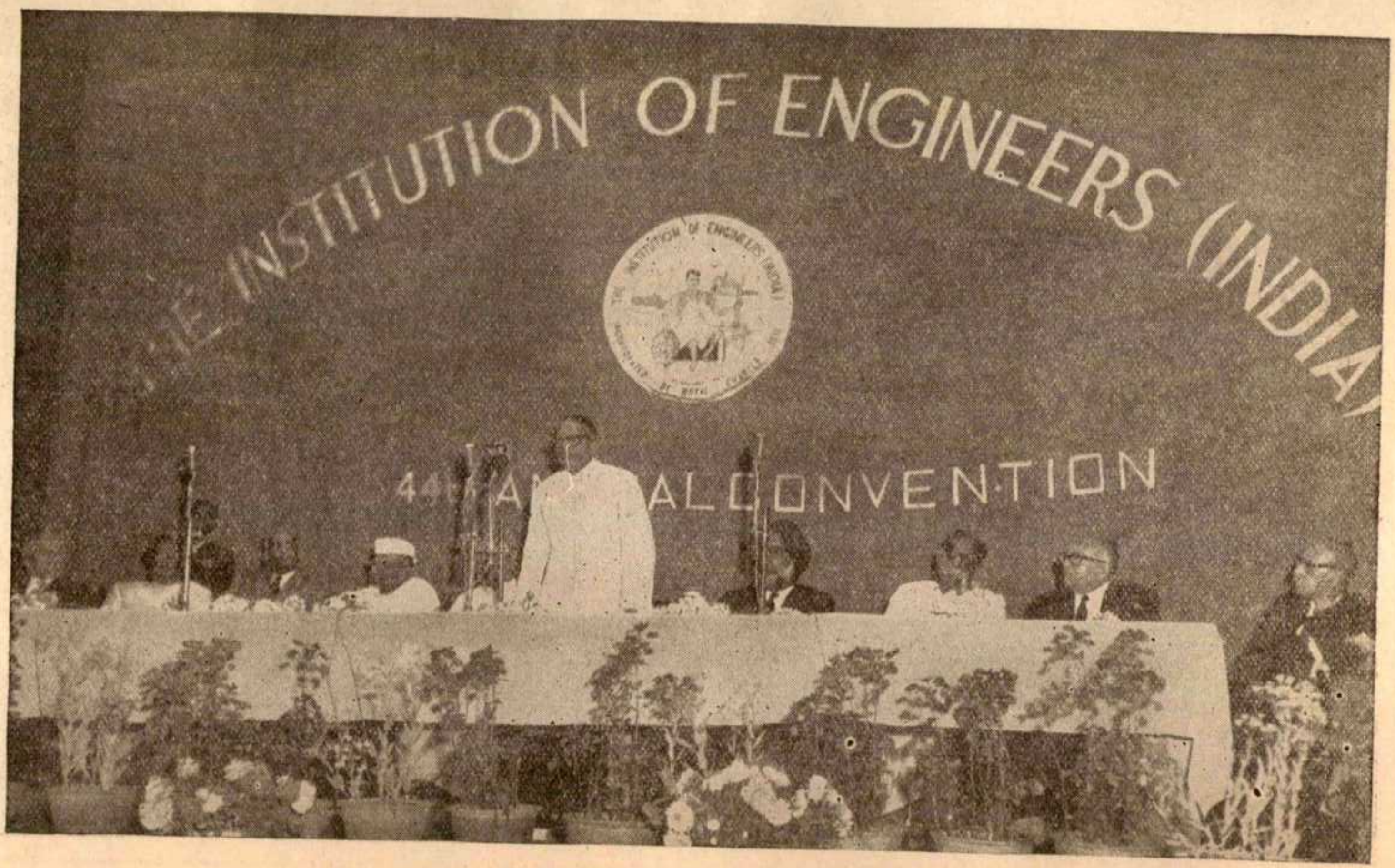
44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



Dr. Sen Delivering the Presidential Address

Ravindra Bharathi, Hyderabad, where the Inaugural Session was held

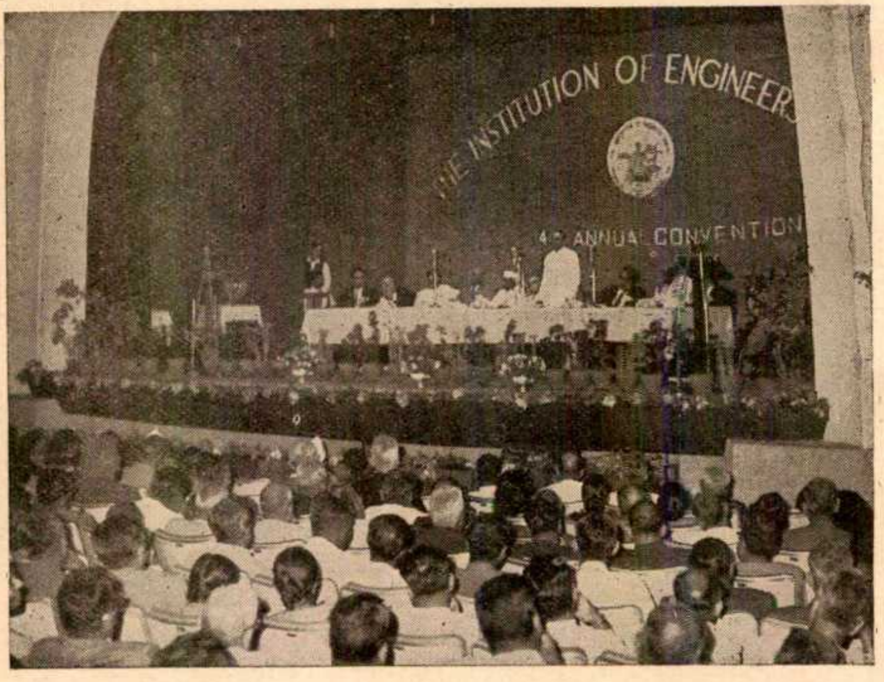
44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



DR. RAO DELIVERING THE INAUGURAL ADDRESS

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964

BRIG. M. K. RAO PROPOSING A VOTE OF THANKS TO DR. RAO, SHRI SANJIVA REDDY, AND OTHER GUESTS



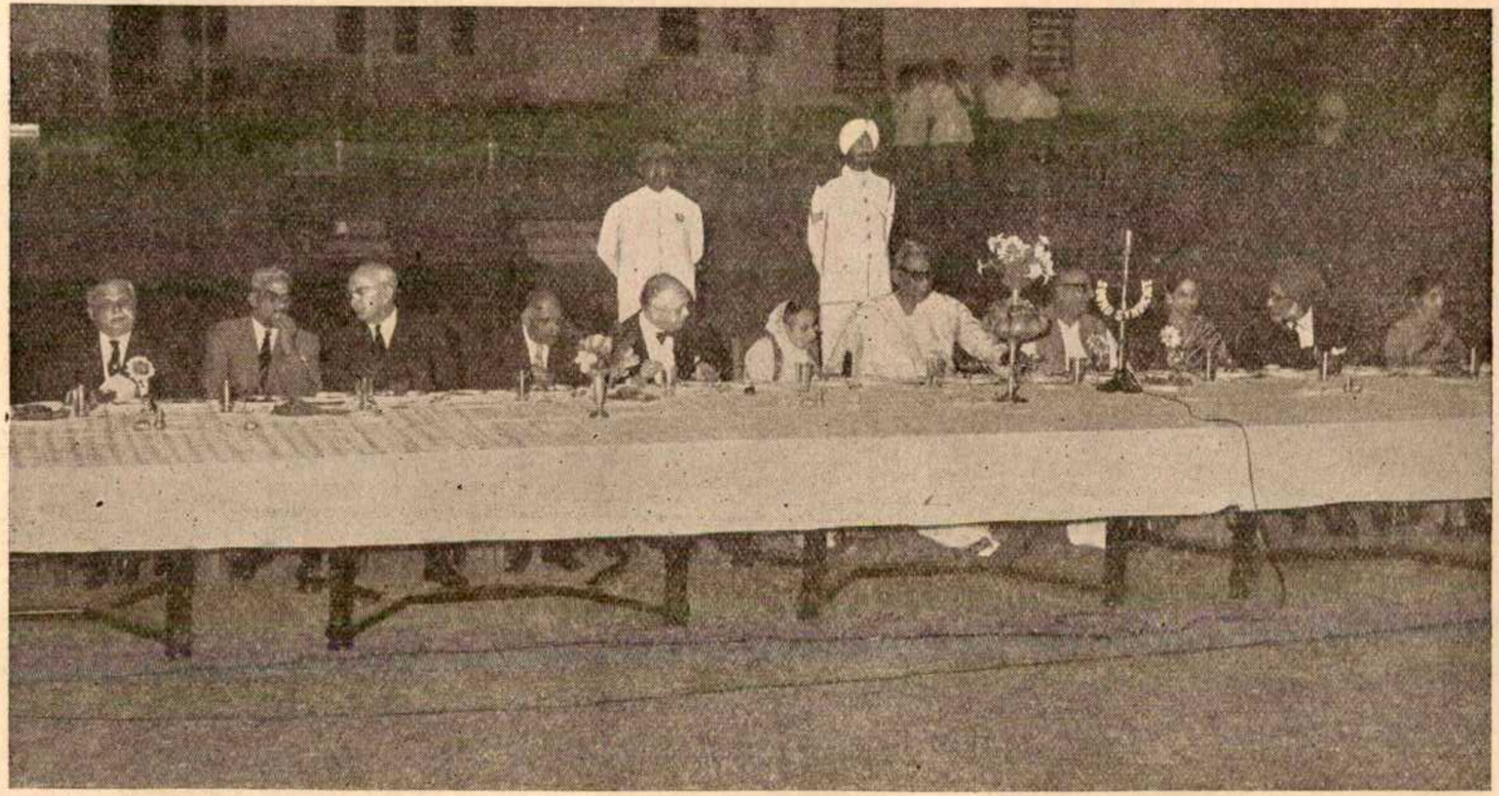
DR. RAO DELIVERING THE SEVENTH SIR MOKSHAGUNDAM VISVESVARAYA LECTURE

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964

A HISTORIC PICTURE, TAKEN AT THE CONCLUSION OF THE INAUGURAL SESSION—THE EIGHT INSTITUTION PRESIDENTS WHO ATTENDED THE CONVENTION

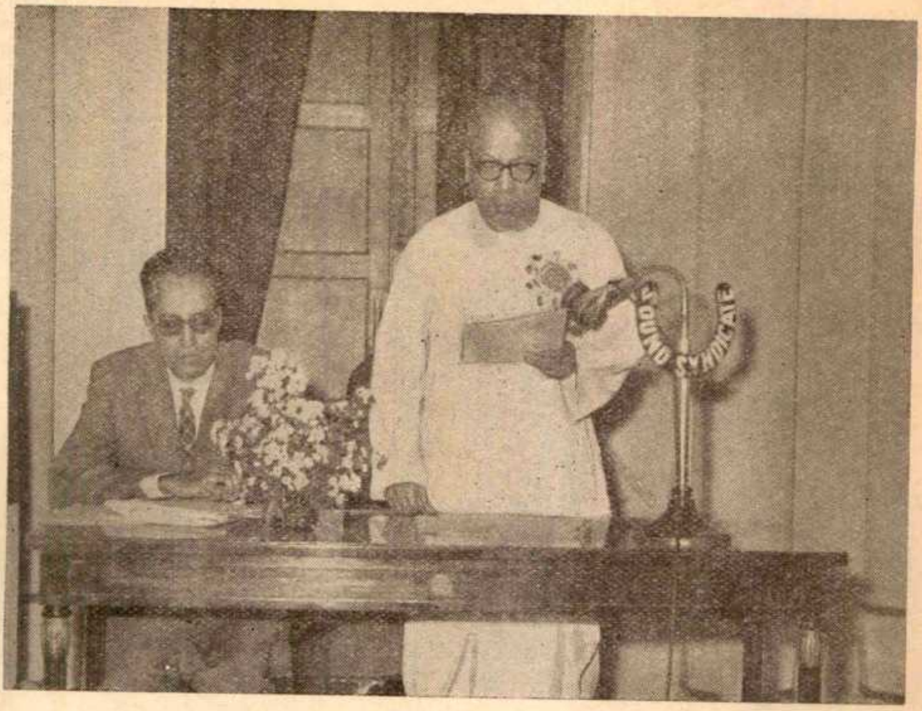
(*L. to R.*) S. B. JOSHI (1954-55), D. P. R. CASSAD (1957-58), DR. T. SEN (1962-63 AND 1963-64), DR. K. L. RAO (1958-59 AND 1959-60), MAJ.-GEN. HARKIRAT SINGH (1960-61 AND 1961-62), DR. M. S. THACKER (1955-56), LT.-GEN. SIR HAROLD WILLIAMS (1953-54), DILDAR HUSAIN (1952-53)

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



44TH ANNUAL DINNER

44TH ANNUAL GENERAL MEETING, HYDERABAD, FEBRUARY 1964



DR. SEN SPEAKING AT THE CLOSING SESSION AT JUBILEE HALL

JUBILEE HALL, PUBLIC GARDENS, HYDERABAD

2. *Resolved* that any Corporate Member belonging to a Division and having a major interest in the activities of any one other Division should have the facility to receive the technical publications of that Division without any additional charge.

3. *Resolved* that the Public Health Engineering Division expresses its keen interest in the International Conference on Water Pollution Research to be held in Tokyo in August 1964 and lends its wholehearted support by sponsoring this Conference on behalf of the Institution of Engineers (India) together with the CPHERI and the Ministry of Health, Government of India.

Further *Resolved* that two members of the Public Health Engineering Division be sent to this Conference.

4. *Resolved* that the Public Health Engineering Division welcomes the Symposium on 'Water Treatment' to be arranged in Nagpur in November 1964, and expresses its desire to participate in this Symposium and co-sponsor it with CPHERI.

(vi) Prof. N. S. Govinda Rao (*M.*), retiring Chairman, Civil Engineering Division, said that proceedings in his Division opened with Chairman's Address. This was followed by a record discussion of 22 papers in four sessions. A wide variety of subjects in the civil engineering field were covered by these papers, and a large number of members took part in the discussion.

Two lectures were also given by Guest Professors. These were 'Cooling Towers' by Prof. G. C. Parkinson and 'California Water Plan or Central Valley Development' by Prof. Sicular.

A Symposium on concrete construction was held and papers were presented. Considerable discussion on the papers also took place.

At the conclusion of the proceedings, three resolutions were adopted by this Division for consideration of the Corporate Members. These were :

1. *Resolved* that a Committee be formed with Dr. Jai Krishna (*M.*), as Convenor for the study of earthquake resistant structures.

2. *Resolved* that a Committee with Shri K. K. Nambiar (*M.*) be formed for the preparation of specifications for prestressed concrete.

3. *Resolved* that the brochure being prepared by Shri Dinesh Mohan (*M.*) on fly ash be considered by the Council in due course and published by the Institution.

(vii) Shri R. M. Patri (*M.*), Chairman, Industrial Engineering Group, said that the proceedings in his Group started with his Address in which the latest advances in industrial engineering were reviewed.

Four papers were scheduled for discussion and two of these were introduced. This was followed by a good deal of discussion.

(viii) Shri M. Ganapati (*M.*) spoke on the proceedings in the Railway Engineering Group. He said that as the Chair was vacant in this Group, Shri D. C. Baijal (*M.*)

had taken the Chair. Shri Baijal, however, was not able to be present. There was an interesting general discussion on many railway problems.

(ix) Shri N. N. Purandare (*M.*), Chairman, Structures Group 1—Prestressed Concrete, referred to the decision taken at the 43rd Annual General Meeting between the Civil Engineering Division, his own Group, and Structures Group II—Shell Structures on the apportioning of work between them. He said that this however, did not seem to have become effective and there was a considerable overlap of papers, particularly in the Symposium on 'Concrete Construction' which had been held under the Civil Engineering Division.

He reviewed in his Chairman's Address the latest developments in the field of prestressed concrete, information on which had been obtained through the Fédération International de la Précontrainte.

He then said that the following resolutions were adopted by his Group jointly with Structures Group 2—Shell Structures for the consideration of Corporate Members.

1. *Resolved* that the Secretary be asked to assess how many of the members of the Civil Engineering Division would like to be categorized as structural engineers, *viz.*, structural engineering is their primary interest. At this stage, it involves only collection of data.

2. *Resolved* that the President of the Institution be requested to approach the Council of Scientific and Industrial Research to establish a research centre in bridge and structural engineering at a suitable centre which could be used by practising structural engineers in the public and private sectors.

3. *Resolved* that the Chairmen of Structures Groups 1 and 2 be authorized to contact persons and firms to institute awards and prizes for the structural engineering groups.

(x) Shri G. S. Ramaswamy (*M.*), Chairman, Structures Group 2—Shell Structures, said that the Chairman's Address dealt with the worldwide developments in shell structures. He also referred to the resolutions which had already been read out by the Chairman of Structures Group 1—Prestressed Concrete.

(xi) Shri V. Y. Kamat (*M.*) said that he had been made the Convenor of the Symposium on 'Small Scale Industries' by the Engineering Research Committee which had initiated the Symposium. Considerable amount of work had been done in this regard during the year, and this led to the presentation of five papers. The papers were followed by lively discussion.

He said that at the end of the proceedings, Shri D. P. R. Cassad (*M.*), who was in the Chair, summarized the proceedings of the Symposium.

(xii) Shri K. K. Nambiar (*M.*) said that he was giving a brief report on behalf of Shri S. R. Mehra (*M.*), Chairman, Roads and Road Transportation Group, who was not present. He said five papers were scheduled to be read at the paper meetings. Out of these, three were introduced by the authors. The ensuing discussion was good.

(xiii) Shri Dildar Husain (*M.*), who took the Chair at the Students' Session on 8th February, said that the proceedings at the Students' Session opened with his Chairman's Address, in which he described the Students of the Institution and all other students of engineering and technology as India's golden horde which was to enrich her future by the exploitation of her natural resources for the needs of her people. He described the diversified fields of engineering development, and the opportunities that lay before the students in the years ahead.

He said that a special brochure which had been prepared by the Andhra Pradesh Centre, containing articles by senior members, was a feature of the occasion.

Four papers were then presented and discussed. Following the Council's decision earlier in the day to award prizes annually for the best papers presented at the Students' Session, the prizes, as awarded at the Inaugural Session, were given.

He said that at the end of the proceedings, two resolutions were adopted by the Students. These were :

1. *Resolved* that the Council be requested to pursue vigorously the non-recognition of the passing of Sections A and B of the Associate Membership Examination of the Institution with those States where such recognition had not been granted.

2. *Resolved* that Book Banks be established at Local Centres on the same pattern as are now being established at engineering colleges in the various areas under the auspices of the Institution.

(xiv) Shri T. R. Mehandru (*M.*) said that he had been requested to take the Chair of the Hindi Section in the absence of Shri Brijmohan Lal (*M.*), Adviser, Hindi Section, who had been unable to attend the Convention. He said he was at a serious disadvantage in doing so as he was not adequately conversant with Hindi to conduct the proceedings.

He added that one paper had been presented and that was by Shri Vishwambhar Prasad (*A.M.*) entitled 'Valuation of Immovable Properties', which had been awarded the President of India's Prize for the best paper in Hindi. Some discussion followed after the paper was presented.

With the permission of the President, Shri Hukam Singh (*M.*), Secretary, Indian National Group for International Association for Bridge and Structural Engineering, said that in reference to the resolution adopted by the two Structures Groups that a special research centre should be established for bridges, considerable work in this direction was already being done at the Central Building Research Institute in Roorkee and Central Road Research Institute in New Delhi. He, therefore, did not think it was necessary to start a further establishment for this purpose.

The President said that the various resolutions moved at the Session would be placed before the Council for consideration at their next meeting.

The President then concluded as follows :

'I have now the very pleasant duty of extending our warmest thanks to the Andhra Pradesh Centre for acting as hosts on the occasion of this Convention and for their unbounded hospitality during the last few days. Our appreciation has to be given in a double measure particularly as the arrangements, which have been very elaborate and thorough, had to be made in record time owing to the fact that the venue of the Convention was changed from Chandigarh to Hyderabad in late October last year.

I can tell you now that many of us were more than a little anxious if the arrangements could be made and made well. The results have certainly far exceeded our expectations, and our sincere thanks are due to the Andhra Pradesh Centre.

I wish particularly to mention the names of Shri A. C. Subba Reddy, Minister for Public Works and Chairman of the Reception Committee, Shri Dildar Husain, Past-President, who invited us to Hyderabad for the Convention, Brig. M. K. Rao, Chairman of the Andhra Pradesh Centre, Shri R. M. Patri, Honorary Secretary, and Major R. S. Attre, Organizing Secretary.

The work of organizing the Convention proceeded under the inspired and personal guidance of Brig. Rao, and, of course, Shri Dildar Husain. They were ably supported by Shri Patre, himself a Past-Chairman of the Andhra Pradesh Centre, who had accepted another term as Honorary Secretary specially to help organize the Convention, and the indefatigable Maj. Attre. They have worked with a zeal which has amazed me, although I have only seen a fraction of their efforts. Everything had to be done in three short months, and you will agree, these gentlemen have overcome all obstacles to make this Convention a remarkable one, made possible by the excellent and untiring Corps of Electrical and Mechnical Engineers.

Our thanks are also due to the members of the Committee of the Andhra Pradesh Centre, the members of the various Sub-Committees who were reponsible for the arrangements for the technical meetings, transport, catering, local visits, hospitality, ladies' programme, outstation tour, and so on. I would also like to thank the student volunteers who have been attending to many details of the arrangements.

Our special thanks must be given to the Ladies' Committee, who have so kindly and generously looked after the visiting ladies, shown them round this beautiful city, taken them to shopping centres, and otherwise entertained them.

I have to thank the Prestressed Concrete Co. of South India Ltd., the Pioneer Engineering Syndicate, and Nagabhushanam & Co., for their excellent Dinner on the 8th. My thanks are also due to Shri T. R. Gupta, of Jay Engineering Works, Ltd., for his excellent Dinner last night. Tonight, we shall be the guests of the Andhra Pradesh Government at another Dinner, and I would like to express my appreciation now for their hospitality.

I must express our warm thanks to Shri Banarsilal Gupta, Mayor of Hyderabad, for the At Home he is giving to the delegates immediately after this Session.

Our thanks are again due to Larsen & Toubro Ltd., for their Lunch on the 9th; the United Provinces Commercial Corporation for their Film Show and Cocktails on the same evening, Patel Engineering Co. for their Lunch on the 10th, and The Andhra Pradesh Electrical Equipment Corporation for their Lunch today. Thanks are also due to Premier Automobiles for their Tea after the Inaugural Session, and Mahindra and Mahindra for the teas arranged during the paper meetings.

I must also express the grateful thanks of the Institution to the Government of Andhra Pradesh for all the facilities they so readily extended to our Andhra Pradesh Centre, which primarily made it possible to make all the extensive arrangements in so short a time.

The Road Transport Department of the State deserves our particular thanks for all the transport they have put at the disposal of our Andhra Pradesh Centre and the help and assistance they have generally given in making the transport arrangements.

I am sure all of you enjoyed the Variety Entertainment last evening. Our thanks are due to those responsible for organizing it and the artists who took part in it. I should also like to render similar thanks in advance to the *Qawwali* programme arranged for this evening.

A number of local visits have been arranged for tomorrow, and on your behalf, I must express our thanks to the managements of Hyderabad Allwyn Metal Works, Ltd., Jay Engineering Works, Ltd., E.M.E. School, No. 1 E.M.E. Centre, and Praga Tools Corporation, for their courtesy in making the visits possible and for the lunches and teas which have been arranged during the visits.

During the outstation visits which also will commence tomorrow, many facilities for the visiting delegates will be extended by those in charge at the Manjira Barrage, the Prestressed Concrete Pipe Factory at Patancheru, and the Nagarjunasagar project. I would also like to thank them in advance for these courtesies'.

With a vote of thanks to the Chair, the Session concluded at 5.30 p.m.

Social and other events

Annual Dinner

The Forty-fourth Annual Dinner of the Institution was held on Sunday, 9th February, 1964, at the Public Gardens, Hyderabad. Shri A. C. Subba Reddy, Minister of Public Works Department, Government of Andhra Pradesh, was the Chief Guest. Many guests and over 400 members attended the Dinner.

After dinner, the President, Dr. T. Sen, requested the guests and members to rise and drink a Toast to the President and the Republic of India.

The President, Dr. Sen, also proposed a Toast to the Chief Guest. Shri Subba Reddy replied to the Toast.

Shri Dildar Husain, Past-President, proposed a Toast to 'Our Guests'. Shri O. Pulla Reddy, I.C.S. (Retired), replied to the Toast on behalf of the guests.

Finally, a Toast to the Institution was proposed by Shri V. K. Rao, I.C.S., Secretary, Industries and Commerce, Government of Andhra Pradesh. Maj.-Gen. Harkirat Singh, Immediate Past-President, replied on behalf of the Institution.

Students' Session

The Students' Session was held on the evening of February 8. About 80 Students attended. Shri Dildar Husain (*M.*), Past-President, was in the Chair. The President, Dr. T. Sen, Shri D. P. R. Cassad, Past-President, Shri J. Datt (*M.*), who took the Chair at the Students' Session at the 43rd Annual Convention, and many senior members were present. A special brochure, 'Undergraduates' Cocktail', which had been prepared by the Andhra Pradesh Centre, containing articles by senior members, was a feature of the occasion.

The proceedings opened with an Address by the Chairman, in which he described the Students of the Institution and all other students of engineering and technology as India's golden horde which was to enrich her future by the exploitation of her natural resources for the needs of her people. He described the diversified fields of engineering development, and the opportunities that lay before the Students in the years ahead.

Some of the Students then spoke on the problems which faced them. Replies giving advice and assuring assistance were made by Shri D. P. R. Cassad, Shri J. Datt and Prof. N. S. Govinda Rao, and, finally, by the Chairman.

Four papers were then presented and discussed. Following the Council's decision earlier in the day to award prizes annually for the best papers presented at the Students' Session, the following awards were announced by the Chairman in consultation with a panel of judges :

(1) A prize of Rs. 75 to Shri B. Nagaraja Rao for his paper 'Lasers', as the best paper presented.

(2) Prizes of Rs. 50 each to Sarvashri P. N. Shetty, G. C. Kelkar and P. G. M. Murthy for their papers 'Emergency Releases of Master Controller Handle and Flat Wheels in an Electric Train', 'Effect of Cement Quality of Coarse Aggregate to Fill a Specified Volume of Concrete', and 'Valve Setting in Locomotives'.

Popular Lecture by Dr. M. S. Thacker

A popular lecture on 'Some Engineering Problems in the Fourth Five Year Plan' was delivered by Dr. M. S. Thacker, Honorary Life Member, and Member, Planning Commission, at the Jubilee Hall on the evening of February 9, 1964.

Dinner by Shri T. R. Gupta

A Dinner was given by Shri T. R. Gupta (*M.*), General Manager, Jay Engineering Works, Ltd., to the delegates in the lawns of the Public Gardens on 10th February, 1964.

تقریر، ڈاکٹر ٹی سین، صدر نشین انسٹیٹیوٹ آف انجینیرس انڈیا

موجودہ بہنو اور میرے انجینیر بھائیو!

مجھے اس وقت یہ بات کہنے میں بہت خوشی ہے کہ آندھرا پردیش کے
لوگوں اور یہاں کے انجینیروں نے ہندوستان کے سارے انجینیروں کا دل لوٹ لیا ہے
آپ کی محبت، آپ کا خوبصورت شہر، آپ کا کلچر، آپ کی مہمان داری،
آپ لوگوں کا بڑا دل، کس کس کی تعریف کی جائے۔

ان سب خوبصورت چیزوں کے ساتھ کل "رویندر بھارتی" میں "مُنڈ ڈانس"
اور آج یہ "سُنڈ قوالی" کے بعد جی چاہتا ہے کہ ہم سب حیدرآباد میں اپنا گھر بنالیں۔

آپ لوگوں کا شکریہ بولنے کے لیے میرے پاس شبد نہیں ہیں ؎
جانا ہے ہمیں یہاں سے چلے جائیں گے ، پر دل مگر اپنا یہاں چھوڑ جائیں گے

اب میں آپ سے پیار تمنا کرتا ہوں کہ آپ سب "تھری چیرس" دیں۔

"حیدرآباد، زندہ باد" !

Speech by

Dr. T. Sen, PRESIDENT*

Sisters and my engineer brothers,

I feel very happy to say that the people and engineers of Andhra Pradesh have stolen the heart of the engineers from all over India.

Your love, your beautiful city, your culture, your care for your guests, your large-heartedness, are all beyond praise.

Along with all these beautiful things and after yesterday's lovely dances at Ravindra Bharati and today's delightful *Qawwali*, we all feel a desire to make our homes in Hyderabad.

I have no words to express my gratitude to you.

'We have to go, and therefore we will leave, but we leave our hearts here.'

Now I request you to join me in saying three cheers '*Hyderabad Zindabad*'.

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*Translation of original speech in Urdu on the reverse.

Lecture by Shri S. K. Biswas

A special lecture was delivered by Shri S. K. Biswas (*A.M.*), Assistant Professor of Mechanical Engineering, Bengal Engineering College, Sibpur, on 'Nuclear Power Stations,' at the Jubilee Hall on the forenoon of February 11, 1964. A film was also shown on the subject.

'At Home' by the Mayor of Hyderabad

The Mayor of Hyderabad, Shri Banarsilal Gupta, was 'At Home' to the delegates on the lawns of Public Gardens on the evening of February 11, 1964.

Dinner by the Government of Andhra Pradesh

Another Dinner was given by the Government of Andhra Pradesh to the delegates in the lawns of the Public Gardens on February 11, 1964.*

'Variety Entertainment' by the Andhra Pradesh Centre

Variety entertainments were arranged by the Andhra Pradesh Centre at Ravindra Bharathi on the evenings of February 10 and 11, 1964. The performances were well attended.

Qawwali programme

A Qawwali programme was arranged by the Andhra Pradesh Centre in the Public Gardens on the night of February 11, 1964. It was well attended and hugely enjoyed.

Local visits

The delegates were taken on many local visits and tours of inspection. Among the places visited were: Hyderabad Allwyn Metals Works, Jay Engineering Works, Ltd., E.M.E. School (South), No. 1 E.M.E. Centre, Praga Tools Corporation, Industrial Estate, Sanatnagar, Salar Jung Museum, and the Char Minar. Lunches or teas were given to the delegates by the various firms and authorities.

Study tours

Two study tours were arranged at the conclusion of the Session. These were:

Tour no. (a): Manjira Barrage and Prestressed Concrete Pipe Factory at Patancheru, and

Tour no. (b): Nagarjunasagar project.

The delegates left Hyderabad on 12th February, 1964. They returned to Hyderabad on 13th or 14th and dispersed to their respective home stations.

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* After the Dinner, Dr. Sen thanked the Government of Andhra Pradesh in a short speech delivered in Urdu. The text of the speech appears on the opposite page.

Dr. T. Sen
President
1963-64

PRESIDENTIAL ADDRESS

The Council has done me the high honour of electing me President of the Institution for a second year. I am deeply conscious of the distinction thus conferred on me. I shall do my best to discharge the heavy duties which thus once again bear upon me, and in this I depend on my colleagues in the Council for their advice and support.

I propose to take the Institution itself for the theme of my present Address. Having with us as our Chief Guest an engineer who has attained the position of a Minister of the Cabinet of the Indian Union, I feel this to be a fitting occasion when to recall the devoted efforts, often in the face of great indifference and discouragement, of our early Presidents, Councils, Committees, members, permanent staff and other stalwarts, who gave so much of their time, wisdom and energy to build up this Institution on so sure and firm a foundation. They never lost faith in the great future which awaited it. By 1935, the Institution had attained sufficient prestige and importance to be granted a Royal Charter. Let not subsequent events cloud the significance of that grant. It was an outstanding event in the history of Indian professional bodies, as it was the first Royal Charter granted to a body which had its origins and functions in India.

The prestige attained by the Institution and the service it had rendered through forty continuous years tended somewhat to be bypassed in the 1950's. I have pondered this problem and cannot but conclude that part of the blame for such developments must rest on the Institution itself. For reasons into which it will serve little purpose now to delve, it would seem not to have met the professional needs of engineers from all branches, thus leading to the establishment of other engineering societies. Many of you are probably aware of the efforts made by us in very recent years to effect a merger of these societies with the Institution, efforts which have not met with success.

It is, therefore, all the more necessary that the Institution remains continuously aware of the duties for which it was constituted. The objects and purposes of its being are well set out in our Charter. The very first of these, the promotion and advancement of the science and practice of engineering in all its branches, is so clear and comprehensive a statement of purpose that it should provide the guiding beacon for the activities of the Institution.

The Charter and the Bye-laws, a new version of which was adopted by the Corporate Members in General Meeting in October last year, are interdependent documents and should be studied jointly in our efforts to further the Institution's work. They, together, describe clearly the limits of deviation within which it is intended that the Institution should function and progress. But because of this very clarity, the most careful study of them still will not give more than a knowledge of the bare framework on which the Institution's activities are built.

In the new Bye-laws of the Institution, great care has been taken to ensure that all branches of engineering and all interests of the Institution are fairly represented. The Council is assisted by a number of Committees, each of which considers and reports to the Council on matters relating to the particular activities of the Institution which lie within its own terms of reference. In the Council, each of these matters is again laid open for discussion to fresh minds, with perhaps a wider range of outlook, and the recommendations of the Committees are then either confirmed, modified or referred back to them for further consideration.

When a subject comes up that is of major importance and may profoundly affect the interests of an Institution, the Council appoints an *adhoc* Committee to deal as exhaustively as may be necessary with that one specific problem. Some of the outstanding achievements of the Institution have been obtained in this way.

Local Centres and the growing number of Sub-Centres play a vital part in the organisational and dispersion of activities of the Institution. The growth of the Institution has necessitated the decentralisation of activities under the control of the Council. Such decentralisation allows a considerable measure of autonomy to those in charge of the Local Centres in order that the needs of a large number of members so widely dispersed and of varied interests may be met satisfactorily. Meetings and visits arranged by Local Centres provide a stimulus to their members by the discussion of matters which are of special interest in their own regions. They also give an opportunity for such members to join in the corporate life of the Institution, a privilege which they would not be able to enjoy if all activity was concentrated at the Headquarters. The manner in which the Local Centres discharge their duties and seek to promote the higher interests of the Institution is a source of constant satisfaction. The honorary workers of successive Committees of the Local Centres have rendered collectively and individually meritorious service which is not generally realised. There is no doubt that the strength of the Institution will be in no small measure due to the activities of the Local Centres and Sub-Centres.

The real check on the health of the Institution lies in the figures for membership, particularly in the figures of Associate Members in whose hands the wellbeing of the Institution will remain in the coming years, and to a lesser extent in the figures of Graduates and Students in terms of the distant future. I am glad to be able to tell you that these figures are continuously rising and at a steep rate. The membership stands at over 46,000—a significant figure remembering that the Institution was founded on a strength of 138 members in 1920. During the course of this year, I expect it will exceed all other Commonwealth Engineering Institutions in numbers.

The weight of its counsel has been increasingly felt in the Commonwealth Engineering Conference.

The job of ensuring that a high standard of entry into the various grades of membership intended in the Bye-Laws is being maintained. Here I may mention an important matter which is now receiving consideration. This is in the accrediting of educational qualifications for exemption from Sections A and B of the Associate Membership Examination.

There was a time when the Institution's list of accredited qualifications determined the eligibility of candidates for entrance into the public engineering services. With the setting up of other organisations within Government, this position was whittled away, and the main purpose of accredition by the Institution today seems to be for the purpose of adjudging the entry of applicants for membership to the Institution. The result is that more or less identical work is being carried out by more than one organisation, which to me seems nothing short of a national waste in this very important matter.

I had, therefore, been thinking in terms of an Accrediting Board at a national level comprising representatives from the interested organisations such as the Ministry of Education and the Union Public Service Commission, which could act for the country as a whole. It is very much my hope that these proposals will take shape during this year of my office.

The Associate Membership Examination conducted by the Institution was reshaped and enlarged in order to cater as fully as possible for aspirants in all the main branches of engineering, and came into operation in late 1961. It is intended to be a test of a candidate's knowledge of the principles in the branch of engineering he has preferred and of his ability to apply these principles to practical problems. It requires a standard in these subjects at least equal to university degree standard.

A review of the Institution's examinations shows that far from there being any relaxation, there has been a definite raising of standards. It is all the more regrettable therefore that some of the State Governments are still not able to see their way to accord due recognition to the passing of Sections A and B of the Associate Membership Examination, and treat aspirants to the profession who have passed these Sections on par with engineering graduates.

I have thus far put before you material evidence of the growth of the Institution and of its activities and achievements. There is, however, another matter of no neglible importance to its members. This is the delicate question of 'status'. This is something incapable of being expressed in numbers or depicted in the form of a graph. It can, however, be considered qualitatively by the examination of appropriate evidence.

What exactly do we mean by 'status'? The status of such an Institution such as ours, I submit, is a measure of the recognition and esteem in which the Institution is held by the general public and by the fellow societies in India and abroad. On the latter count, the Institution has already achieved considerable eminence. It is in respect of the former that I have certain anxieties.

This lack of recognition in the public mind in line with its actual activities and achievements is not so very difficult to understand as it appears at first sight. It is inevitable that during a period of far-flung growth of our nationhood as at present that a lag such as this should exist between achievements and public recognition. In the final analysis, the work of the Institution in furthering professional—and by this means, national—interests will not fail to make its mark. Therefore, it is both undesirable and unnecessary to overplay one's had in this delicate matter.

At the same time, it would be but proper to recognise the shortcomings we undoubtedly have in the Institution and set to work to overcome them. To mention one instance, one of the primary activities of the Institution is the publication of technical papers and articles. An unbiassed scrutiny of published material reveals that while meritorious contributions have been made, a substantial percentage of published material has been in the nature of recapitulation or collection of already available knowledge or in the nature of general discussions without making specific further contribution in the fields concerned. I would urge that the vehicle of the Institution's publications should be more strictly confined to valuable material so that whatever is published is authoritative, original, or in some way throws a new slant on engineering problems. The Institution is no longer an infant to throw its publications open to descriptive writing.

It is, therefore, necessary that we do look into matters such as these which, collectively, does matter a great deal to the prestige of the Institution and to the effeciveness of the service it renders. It is with the thought of making this service a little more purposeful that I had broached, during the session which has just ended, to the Council three matters which had been occupying my thoughts for some time.

The first of these was in regard to the difficulties experienced by our Students in preparing themselves for the Institution examinations. These young men commendably arrange for their own practical training, but find real hardship in securing good theoretical and laboratory instruction. If facilities could be made available to them in the engineering colleges and in the polytechnics by the conduct of part-time courses in these institutions, it would serve an immediate purpose. I had discussions with the former Ministry of Scientific Research and Cultural Affairs of the Government of India, and was assured that the Government would not only welcome such a move but also extend financial help, as a measure of increasing the output of technical manpower. The Local Centres were thereafter asked by the Council to follow this matter up in their respective regions, but, regrettably, very little seems to have been achieved.

The second project which I initiated has met with greater success. This was a proposal to establish book banks at the engineering colleges under the sponsorship of the Institution, to provide a substantial base of text-books for engineering students in the prosecution of their studies. By this means, not only are the students immediately benefited, but they also begin to develop a feeling of oneship with the Institution. I hope these students will become Students of the Institution, and thus begin their association with the Institution from the commencement of their professional career. Happily, this project, which also had to be pursued through the Local Centres, has led to some results, and book banks have been established at a few engineering colleges.

The third is the need to help combat early obsolescence of engineers by making readily available to educators and to practising engineers alike, recognised and top quality programmes of continuing education. I believe this to be one of the most important problems facing the engineering profession today. It is my belief that our Institution has an obligation to play a major role in any national programme of continuing engineering education and must move seriously and rapidly to organise refresher courses and seminars on important subjects of national importance. Here again, I have to admit that not much seems to have been achieved.

The States and the Centre are preparing their Fourth Five-Year Plans. Can we not, the educators and the practising engineers, hold discussions and seminars at all our Centres on those plans which are mainly engineering ?

In admission of my disappointment over these proposals, I addressed the membership in a letter which was published in the last November issue of the *Bulletin*. The response to this letter has been very encouraging, and I would very much like to endeavour to bring them to some kind of fruition during the coming year.

Lastly, I call for a reaffirmation and rekindling of the strong sense of ethics and dedication to the observance of high moral principles that have characterised engineers in the past as the protectors of public health, welfare and safety. In the face of repeated disregard of ethical concepts and procedures in the fields of politics, business, and, unhappily, also at times in the profession, a mere reaffirmation of our beliefs is not enough. We must by precept and example and also by direct teaching, make our students aware of obligations they as engineers are about to assume. We must also demonstrate our sincerity by our own conduct and by participating and being heard on local, State and national levels, when matters in our fields of special competence that involve engineering responsibilities and affect the public interest are at issue, The overall picture of the Institution which therefore emerges is one of considerable achievement along the road set out for it by the Charter and a very rapid growth in membership in the last few years, with an array of important and urgent problems lined up in its front at the present day. Whilst we can all feel proud of the growth in strength and achievements of the Institution in the past, there can be no room for complacency in the solution of these problems.

I want to acknowledge with gratitude the love, respect and co-operation that I received from the members of the Council and the Staff during the last year. I am deeply indebted to them.

I know I speak for all of the incoming members of the Council when I pledge our best efforts to further the policies and objectives of the Institution during our tenure, and I express to all of you, the members of the Institution, our deep appreciation for your vote of confidence.

Summaries of Papers Published in the Journal vol. 44, no. 7, pts. CI 4, ME 4 and MM 2, March 1964

CIVIL ENGINEERING DIVISION

Investigation of Shear Properties of Sands by Triaxial Shear Tests

S. Panchanathan
Member
and
S. V. Ramaswamy
Non-member

The results of triaxial shear tests conducted on some air-dried Indian sands for determining their shear characteristics are presented. An attempt is made to study the relationship between shear resistance and: (i) relative density, (ii) particle size, and (iii) gradation. The conclusions reported are based on an analysis of 56 individual shear tests. The results indicated that the angle of internal friction increases with increasing relative density, the relationship being approximately linear up to about 60% relative density. At higher relative densities, the increase in the angle of internal friction with relative density is correspondingly less. With the available results, a parabola was fitted for this behaviour pattern, and the relationship between relative density and ϕ was found to be of the from $\phi = 28.4756 + 16.3149\, R.D. - 5.6162\, (R.D.)^2$, where *R.D.* is expressed as a fraction and ϕ is in degrees. It is found for soils with similar gradation ϕ increases with decreasing particles size and ϕ increases with better gradation as evidenced by increase in its value with C_R.

Some Aspects of Design of Chutes

C. R. M. Patnaik
Non-member

There are, at present, no standard method of design of chutes which may be required on irrigation canals in the place of a series of drops in a steeply failling country. The study presented in this paper was necessitated to examine the extent to which the conventional methods of design answer the real needs of economy both in cost and loss of utilizable head of water.

Utilizable Yield and Dependability of Madhya Pradesh Catchments

D. S. Sinha
Member

In the design of irrigation storage reservoirs, several factors govern fixation of the full tank capacity. The most important consideration is the dependable yield. For a given catchment, however, the cost variation per unit storage for differing tank capacities is also a factor which merits consideration. In this paper, performance of some of the major irrigation systems in Madhya Pradesh spread over a number of years has been described. The analysis brings out the probability behaviour of catchments in different regions. Based upon this and also upon the data available for unit cost variation, tentative conclusions have been arrived at, which could form the basis for fixation of tank capacities in the State. For purely *rabi* tanks meant for post-monsoon withdrawals, a capacity, ranging from 60 to 70% of the average annual yield, has been favoured. For kharif (monsoon) irrigation a 50 to 60% tank would be desirable because the demand is most accute when the rains are scarce. Such tanks must, therefore, have a high dependability. Where a tank is meant to supplement and stabilize irrigation from diversion of river flow, it should have a high capacity, *i.e.*, equal to or more than the average annual yield. The above percentage harnessing of river inflows and the consumptive water requirements for irrigation in the State have been correlated and a rough estimate made of the water that could be released from Madhya Pradesh catchments, for downstream use in interstate irrigation projects.

Some Problems in the Application of Common Pumping Test Methods to Field Conditions

B. B. S. Singhal

Non-member

Thesis formula and its modification, Jacob-Thesis formula, are commonly used to determine the coefficient of transmissibility, T, and the coefficient of storage, S, of an aquifer. In the development of these formulae, some assumptions are made which are rarely valid under the natural conditions. The effects of these deviations on pumping test data and the modifications of the Theis' formula under special field conditions are described in this paper. Four problems are described in the paper: (i) heterogeneity of the aquifer; (ii) limited areal extent of the aquifer; (iii) partially penetrating wells; and (iv) leaky artesian aquifers.

RAILWAY ENGINEERING GROUP

Modern Welded Track for High Speed

R. C. Bhandari

Associate Member

From the author's experience while on a study tour to the railway systems of Italy, Switzerland, West Germany, Belgium, France and the United Kingdom, it is pointed out that faster movement of trains is essential in modern times. The requirements for achieving the increase in speed are: (i) powerful Diesel or Diesel-electric engines to haul the trains; (ii) reduction in the time of stoppage to a maximum of 5 min. (on Swiss railways, the time of stoppage is limited to 3 min.); (iii) quicker arrangements for shunting to add or detach coaches; (iv) provision of proper signalling; and (v) proper track for running trains at high speed, *e.g.*, 140 km. per hr. In this paper, the civil engineering problems concerning the provision of a suitable high speed track are discussed.

Track Drainage

P. N. Mehta

Non-member

The interception, collection and removal of water from, upon or under the track to a degree where it will not weaken the track is accomplished not only by surface interception and drainage arrangements but by a sub-surface drainage system.

Safety Measures in the Railways : Catch Siding

K. Ramaswamy

Associate Member

Accidents are not infrequent occurrences on the Indian Railways. Constant effort is being done to analyze the causes of various types of accidents which take place and develop better prevention methods. In this paper, the author deals with a particular type of accident on the railways, *viz.*, the breaking away of a vehicle or using vehicles while ascending a steep gradient. Prevention of accidents may be possible by using improved designs of couplings, adoption of vacuum-brake systems for trains, etc. Measures have to be adopted to protect trains stationed at the foot of slopes. In the paper, the author has suggested the use of catch sidings to solve this problem and has given a note on the design, experimental data, etc. of several types of catch sidings.

ROADS AND ROAD TRANSPORTATION GROUP

Research on Foundation Analyses of Highway Fills on Soft Clays

T. K. Natarajan

Non-member

The paper presents a digest of experience concerning a few of the many-sided aspects of the problem, encountered by the Central Road Research Institute, New Delhi, during its participation in recent years as consultant on earthwork projects in India, involving the construction of fills on tidal flats and marshy ground. Emphasis has been on the undrained strength of clays under sustained loading, and the behaviour of granular fills on soft ground.

Study of Anionic and Cationic Bitumen Emulsion

N. K. Vaswani

Associate Member

The paper explains the three theories propounded for adhesion between aggregate and bitumen and discusses the theory of emulsion and explains the properties of cationic and anionic emulsions. It describes the investigations carried out on three types of aggregates, *viz.*, electropositive, mixed and electronegative.

MECHANICAL ENGINEERING DIVISION

Influence of Nose Radius of a Single-Point Cutting Tool on Surface Finish in Fine Machining

B. M. Agarwal
Non-member
and
S. K. Basu
Associate Member

The paper deals with the effect of speed and feed on the surface finish obtained on work specimens in the case of finish machining of metals on lathes. Keeping the cutting tool angles unchanged, if the nose radius of the tool is varied an optimum value of the nose radius is reached corresponding to which the surface finish obtained on the job is of the highest order. An attempt is made here to express the relationship between the optimum nose radius of the tool and the feed while finish turning various metals on lathes.

Transient Response of Multi-Degree Freedom Systems to Unit Step

P. Srinivasan
Non-member

The usual rule that dynamic deflection is twice the static deflection holds good only for systems with single degree of freedom. When this rule is applied to estimate the maximum deflection of multi-degree freedom systems, the results obtained will be very much in variance with the actual deflection evaluated. To illustrate this fact, two examples are examined in detail. The first example is a turbo-alternator set idealized by three masses in a shaft simulating a two-degree freedom system. A torque of constant magnitude is suddenly applied to one of the rotors, and it is shown that the maximum shaft torque developed is about 33% greater than the torque estimated by the above rule. The second example considered is a conventional automobile, idealized as a two-degree freedom system by considering only the pitching motion in one plane. The automobile is suddenly subject to a unit step and the maximum deflection is computed. A numerical example is considered and for the system constants assumed, it is shown the maximum deflection is much greater than that computed by the usual rule. The analysis is limited to linear systems and for simplicity of analysis, only system with two-degrees of freedom are considered. Laplace transform is employed to obtain the step response or indicial response. The results are of interest to machine designers.

Heat Generated during Clutch Engagement

G. Ramachandra Rao
Non-member

In this paper, an attempt is made to evaluate the heat generated during clutch engagement under severe operating conditions. Clutch engagement characteristics

are obtained from road tests under varying operating conditions and the effect of these on the heat generated and the rate of heat generation is discussed.

Determination of Distribution of Stresses along Tool-Chip Contact Zone

G. R. Ponkshe

Non-member

For calculating the cutting forces proceeding from the shear zone, the first important step is to obtain a correct shear angle relationship. A number of such relationships have been derived by various research workers making different assumptions. These shear angle relationships have formed the basis for calculation of the cutting force, coefficient of friction, etc. from time to time. The results obtained are, however, not entirely satisfactory. An attempt is made in this paper to determine the nature of distribution of normal and friction stresses along the rake surface of the cutting tool. These distribution curves are further used to explain the influence of the cutting parameters on the average coefficient of friction.

INDUSTRIAL ENGINEERING GROUP

Mathematical Programming in Production Control

T. L. Subramanian

Non-member

and

C. A. Gilpin

Non-member

Production planning has become an intense problem with industrial development. Mathematical programming is an effective tool employed widely in production planning. This paper, first in the series, explains the Simplex method, the most general method in mathematical programming. Development of the algorithm and conventional procedures are described.

MINING AND METALLURGY DIVISION

Steel Plant Expansion Scheme of the Mysore Iron and Steel Works, Ltd.

P. C. Balakrishnan

Associate Member

In this paper, the author has described in brief the various aspects of the steel plant expansion scheme of the Mysore Iron and Steel Works, Ltd., Bhadravati, undertaken at a capital cost of Rs. 7 crores. Various aspects such as the plants involved, erection tools and tackles, services and manpower requirements, and commissioning are also dealt with.

INSTITUTION NOTICES

Inclusion of Additional Papers in the Optional Groups of Mechanical and Electrical Engineering Branches of Section B (New Scheme)

For the convenience of candidates appearing for Section B examination in the New Scheme in (i) Mechanical and (ii) Electrical Engineering branches, it has now been decided to add one more optional paper, *viz.*, (i) 'General Electrical Engineering' in the Mechanical Engineering branch, and (ii) 'Hydraulics and Hydraulic Machinery' in the Electrical Engineering branch, with effect from the November 1964 examinations.

Draft Indian Standard

The following draft Indian Standard has been issued recently.

Draft Indian Standard Code of Practice for Design and Construction of Septic Tanks Part II Institutional Purposes—Doc : BDC 24(740).

This Code lays down the recommendations for the design, layout, construction and maintenance of septic tanks and includes methods of treatment and disposal of septic tank effluent. It is applicable to residential housing colonies, hostels and boarding schools where the number of users range between 50 to 300 persons.

Members may send their comments on the above Standard before May 31, 1964, to Shri N. V. Modak (*M.*), Udyam Shivaji Park, Bombay 28, who is the Institution representative on the Sectional Committee dealing with this Standard, and copy to Shri R. S. Mehta (*M.*), Chairman, Public Health Engineering Division, Central Public Health Research Institute, Wardha Road, Nagpur 3.

Copies of the draft Standard may be obtained from the office of the Indian Standards Institution, 'Manak Bhavan', 9 Bhadur Shah Zafar Marg, New Delhi 1, or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1 ; 11 Sooterkin Street, 3rd Floor, Calcutta 13 ; 14/69 Civil Lines, Kanpur ; or 1/12 First Line Beach, Madras 1.

INSTITUTION NEWS

Sir M. Visvesvaraya Statue in Hyderabad

At their meeting held in Hyderabad on February 11, 1964, the Council of the Institution approved of President Dr. T. Sen's proposal of erecting a statue of Sir M. Visvesvaraya in Hyderabad. The suggestion was made by Dr. K. L. Rao (*Honorary Life Member*), Union Minister for Irrigation and Power, at the conclusion of the Seventh Sir M. Visvesvaraya Lecture which he delivered during the Convention. Some contributions were already promised in this connection. The Council directed that a separate bank account be opened with the State Bank of India, by the Headquarters in Calcutta, for receiving the donations made for the proposed statue. The Chairman of the Andhra Pradesh Centre has been authorized by the Council to administer the project.

FORTHCOMING CONFERENCES

1964 Annual Convention of the Institute of Indian Foundrymen, Chandigarh, April 11, 1964

The 1964 Annual Convention of the Institute of Indian Foundrymen will be inaugurated by Shri C. Subramaniam, Union Minister for Steel, Mines and Heavy Engineering, at Chandigarh on April 11, 1964. Synchronising with the convention, the Regional Foundry Station set up by the National Metallurgical Laboratory at Batala will be declared open on April 10, 1964. Dr. B. R. Nijhawan, Director, National Metallurgical Laboratory and President of the Indian Institute of Foundrymen will deliver the Presidential Address on April 11, 1964.

Symposium on 'Problems in Water Treatment', Nagpur, November 1964

The Central Public Health Engineering Research Institute, Nagpur, will hold a Symposium on 'Problems in Water Treatment' in November 1964. Interested persons may send two copies of their papers on or before July 31, 1964 to Dr. N. U. Rao, Central Public Health Engineering Research Institute, Nehru Marg, Nagpur 3. The exact dates of the Symposium will be announced later. Further details may be had from the above address.

20th Meeting of the International Conference on Large Electric Systems (CIGRE), Paris, June 1-10, 1964

The 20th Meeting of the International Conference on Large Electric Systems (CIGRE) will be held in Paris from June 1-10, 1964. Nearly 130 papers will be presented at the meeting in the following four sections.

1. Generation, Transforming and Switching of Current
   - (i) Generators ;
   - (ii) Transformers ; and
   - (iii) Circuit-breakers.
2. Construction, Insulation and Maintenance of Lines
   - (i) High voltage cables ;
   - (ii) Towers and Tower foundations ;
   - (iii) Overhead lines, Vibrations ; and
   - (iv) Insulators.
3. Operation, Protection and Interconnection of Networks
   - (i) Protection and relaying ;
   - (ii) Power system planning and operation stability ; and
   - (iii) Lightning and surges.
4. Power Transmission over 220 kV
   - (i) Extra high voltage A.C.
   - (ii) Extra high voltage A.C.

Several tours to thermal, tidal and nuclear power stations have been arranged for delegates attending the meeting. Further details can be obtained from the International Conference on Large Electric Systems, 112 Boulevard Haussmann, Paris.

International Book Exhibition, Washington, June 7-10, 1964

The Ninth United States International Book Exhibition will be held in Washington, from June 7 to 10, 1964. The exhibition forms an integral part of the 1964 Convention of the American Booksellers Association. It will deal exclusively with books published outside the United States. Now in its ninth year, the International Book Fxhibition has proved to many foreign publishers to be an opportunity to extend their exports to the U.S. market. A participation fee of £6 (or, $ 18) will be charged for the first title and £1 (or, $3) for each subsequent periodical from the same publisher. Up to six copies of each periodical may be sent without additional payment.

Further details can be obtained from United States International Book Exhibition, The A. P. Wales Organization, 18 Charing Cross Road, London, W.C.2.

First International Conference of Women Engineers and Scientists, United Engineering Centre, New York, June 15-21, 1964

The first International Conference of Women Engineers and Scientists, sponsored by the Society of Women Engineers, New York, will be held at the United Engineering Centre, New York, during June 15-21, 1964.

The programme will include symposia on future engineering and science projects and their requirements for engineering and scientific talent; the importance of women as a source of this talent, and proposed approaches to secure the proper education for their work on these projects. The conference desires to invite as delegates those women engaged in engineering and physical science fields, as well as leading men and women in those areas having the greatest influence on the decisions of women in their education and careers.

Members, who are interested in participating in the symposium may write to Mrs. F. R. Smith, Hazeltine Corporation, 59-25 Little Neck Parkway, Little Neck, New York, N.Y. 11362.

Second International Conference on Water Pollution Research, Tokyo, August 24-28, 1964

The Second International Conference on Water Pollution Research will be held in Tokyo during August 24-28, 1964, under the world sponsorship of the Water Pollution Control Federation of the United States of America and under the regional and national sponsorship of more than 25 other scientific and engineering organizations throughout the world.

The main objectives of the conference are : (i) to provide a forum where reports on outstanding research in water pollution from all parts of the world may be presented, and to provide a medium for the publication of such reports; (ii) to provide an opportunity for scientists and engineers engaged in water pollution research to meet and discuss matters of common interest; (iii) to stimulate cooperation among nations in the conduct of research by identifying significant research needs of common interest; (iv) to encourage newly developing nations to participate in the conduct of research on water pollution problems; and (v) to promote international goodwill by providing scientists from many nations an opportunity to pool their research experience and knowledge in the solution of water pollution problems.

The programme will consist of opening and closing general sessions and three concurrent research sessions. The research sessions will consist of three sections covering freshwater pollution, waste treatment, and marine disposal; at each of these sections will be presented 16 research papers with discussions.

Further details of the conference may be had from the Secretary, Second International Conference on Water Pollution Research, Japan City Centre, Tokyo, Japan.

Sixth International Course in Architectural History, Vicenza, Italy, September 9-26, 1964

Andrea Palladio, The International Centre of Architectural Studies, Vicenza, Italy, will present the Sixth International Course in Architectural History from September 9 to 26, 1964. Lectures will be given in the following subjects: (i) Palladio and Palladianism, and (ii) Early Renaissance Architecture in the Veneto. The lectures will be accompanied by vistis to the works of Andrea Palladio and to important examples of renaissance architecture in the Veneto. The list of lecturers include several authorities on the subject from important universities of Europe and America. A certain number of bursaries will be available to assist outstanding students, both Italian and foreign, who wish to attend the course. The lectures will be given in Italian.

Further details can be obtained from the Centro Internazionale di Studi di Architettura, Palazzo Valmarana-Braga, Corso Fogazzaro 16, Vicenza, Italy.

Conference on Power Applications of Controllable Semiconductor Devices, London, November 1965

The Power Division of the Institution of Electrical Engineers, London, will hold a two-day conference in November 1965 on the subject of power applications of controllable semiconductor devices. In this context, the word 'power' is intended to apply to devices capable of handling at least 10 amp. and to equipment of not less than about 1 kW rating.

It is proposed that the scope of the conference should embrace the devices themselves, as well as applications, and include (i) devices (construction, characteristics, testing, rating, performance); (ii) gate circuits, and (iii) applications (*e.g.*, convertor applications, switching applications).

Further details concerning the conference, can be obtained from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Conference on the Application of Large Industrial Drives, London, Spring 1965

The Power Division of the Institution of Electrical Engineers, London, will hold a three-day conference at Savoy Place in the spring of 1965 on the application of large industrial drives. The increase in the use of large motors of 1,000 h.p., and over in industry generally brings many problems. The conference is concerned primarily with the judgment that has to be exercized in introducing such large machines not only in new factories but in existing factories with established distribution systems.

The material for the conference will comprise papers of 1,500-2,000 words in length. Contributions are welcome from all branches of industry, especially the steel and coal mining industries.

Further details may be obtained from the Secretary, The Institution of Electrical Engineers, Savoy Place, London W.C.2.

BOOK ACKNOWLEDGMENTS

1. **Prestressed Concrete.** A. V. Rao. *Sarvodaya Publishers*, Vijayawada 2 (A.P.), Rs. 7.50. 1963, 129 pages.

This book is intended to be of use to engineers and has been written in a descriptive manner avoiding mathematical illustrations. The 'AVRO' system of prestressed concrete, which is the invention of the author, is explained in detail.

2. **Prevention of Electrical Accidents.** M. Subramaniam. *Published by the author*, Rs. 5. 1962, 37 pages.

This book is intended to be a guide to engineers, technicians, and common people, for anticipation, prevention and treatment of accidents due to electricity. Section 1 gives instructions regarding preventives investigations. In Section 2, the causes of electrical accidents are analyzed. Section 3 deals with the various aspects of prevention of accidents, and Section 4 gives the procedures on occurrence of accidents. Proforma used in meeting legal obligations associated with electrical accidents are given in the appendices.

3. **Electrical Systems Maintenance Guides.** M. Subramaniam. *Published by the author*. Rs. 3.75. 1962, 30 pages.

This book is intended for the use of engineers, technicians and workmen engaged in electrical maintenance works. In four chapters, the total scope of electrical maintenance jobs, except those of large E.H.T. systems, are discussed.

4. **A Text-Book of Agricultural Engineering—Part 1 : Surveying.** R. F. Patil. *Published by the Author*, College of Agriculture and Research Institute, Krishinagar, Dharwar, 1963, Rs. 5. 112 pages.

This book is intended for the use of students of agricultural engineering degree courses of Indian universities. It comprises chapters on the various aspects of surveying and includes appendices and a short bibliography. The reader is introduced to the various methods of surveying, levelling, contouring, etc. The questions listed at the end of each chapter serve as useful exercises, and help students to comprehend the text better. The book is illustrated with neat sketches.

5. **Economics for Engineers.** R. K. Amin. *Charotar Book Stall*, Anand (W. Rly.), 1960, Rs. 10. 412 pages.

Intended to serve as an introduction to economics for degree students of Indian universities, this book will be of help to scientists, engineers, and technologists as well. Chapters on business establishments, accountancy, costing, valuation, etc., have been included with this point in view. Brief summaries of the subject matter and examination questions are given at the end of each chapter in this book.

6. **Mitchell's Advanced Building Construction : The Structure.** J. S. Foster. 17th ed., 1963. B. T. Batsford, Ltd., 1st Indian edition. *Allied Publishers Private Ltd.*, Bombay, 1963. Rs. 20. 580 pages.

This is the second volume of the new book—Mitchell's Advanced Building Construction—which is now published in two parts (the companion volume concentrates on Components, Services and Finishes). Beginning with a short chapter on contract planning and site organization followed by a section on contractor's mechanical plant, the various structural elements of a building are discussed in turn. In its new form, the book is intended to be a informative guide to architects and builders.

7. **Pressure Vessel Design.** John F. Harvey. *D. Van Nostrand Co., Inc.*, New York, 1963, $ 9.75. 274 pages.

This book presents the actual design of vessels from material selection, stress theory and design practice to the economics of construction, fabrication and shipment. Included in the book are the latest design methods applied to nuclear and chemical reactors and vessels.

8. **Semi-Conductor Fundamentals, Devices and Circuits.** A. H. Seidman and S. L. Marshall. *John Wiley and Sons, Inc.*, $ 6.50. 1963. 278 pages.

This book provides an understanding of diodes and transistors ; their operation, technology and applications in circuits. This book is intended to be of use to engineers and others engaged in the field of electronics. A familiarity with the principles of elementary physics and vacuum tube electronics is assumed. The first four chapters are primarily concerned with the physics of diodes and transistors whereas chapters 5 and 6 deal with the technology, construction and manufacture. Grown and alloy junction semi-conductors are discussed along with the electrochemical diffused and epitaxial types. Chapters 7 through 11 treat the transistor as circuit element. Chapter 12, introducing digital applications of transistors and diodes, includes an introduction to binary arithmetic. The basic building blocks of a computer are analyzed, and examples of diode-transistor logic (DTL) and not-or (NOR) logic are given. Chapter 13 is devoted to tunnel diodes. In addition to a broad coverage of applications, a qualitative introduction to Fermi levels and tunnelling on a physical basis is given. The concluding chapter presents a basic discussion of diode and transistor measurement. Here methods are developed for obtaining static and dynamic characteristics of these devices. The book also provides numerous illustrative examples to aid in understanding the theory and applications of the principles explained.

LETTER TO THE EDITOR

[Following is an extract from a letter by Premier Publishers (India), 2695A D. B. Gupta Road, New Delhi 5, publishers of a proposed volume entitled 'Men of Science & Technology in India'. This letter is a reply to certain opinions expressed by Shri D. N. Sinha (A.M.) in his Letter to the Editor published in the Bulletin for December 1963.]

Dear Sir,

This volume on 'Men of Science and Technology' shall be ready for despatch in March.

Whatever sad experience the worthy associate member might have got at the hands of some publisher, he was in no way justified in naming and classifying every publisher in the same category.

We convey our strong feelings and would solicit your cooperation in issuing a very early contradiction to the letter.

Yours faithfully,
for Premier Publishers (India)
Sd/-.
Managing Director

Referring to this Shri D. N. Sinha (*A.M.*) has written that his statements originated from doubts based only on previous experiences. He likes to emphasize that he had no intention to cause any disrepute to Premier Publishers (India) even remotely since he is not in a position to underwrite their activities. In any case, he requests the readers to ignore the word 'unscrupulous', unfortunately drafted in his letter with a degree of impatience and would be happy to congratulate Premier Publishers on seeing the volume in question in print.

—*Editor*

OBITUARY

The sympathy of the Institution is extended to the relatives of those whose passing is recorded here

Shri G. K. Ramamurthy

Shri G. K. Ramamurthy, B.Sc. (Hons.), C.I.I.Sc., A.M.A.I.E.E., M.I.E., died on October 3, 1963, at the age of 48.

Shri Ramamurthy graduated in physics from the Madras University. He also obtained a Certificate of Proficiency from the Indian Institute of Science, Bangalore, in Electrical Engineering. He worked as Technical Assistant to the Executive Engineer, Transmission Line Construction, Madras Electricity Department, during 1941-42; as Assistant Engineer in the Indian Steel Rolling Mills, Negapatam, during 1942-43, and as a Branch Manager of Indian Oxygen and Acetylene Co. Ltd. at Madras and Bangalore during 1943-46. From 1946, he took up a new assignment as Engineer-in-charge of Contracts in the Crompton Engineering Co. (Madras) Ltd., and was promoted to General Sales Manager and Projects Engineer in 1960. During his service with the Crompton Engineering Co. Ltd., he was responsible for execution of various high-voltage sub-stations for the Madras and the Andhra Pradesh Electricity Departments.

Shri Ramamurthy joined the Institution as Associate Members in 1956 and was transferred to Member in 1961.

CORRIGENDA

TO VOL. 13, NO. 6, FEBRUARY 1964

Regulations of the Council

Page vii, Regulation 11, line 2, instead of 'Such co-opted members of the Council........', please read 'Such co-opted members of the Committee......'.

Page xvii, line 34, instead of '33', please read '38'.

Page xx, under tables of 'Annual Subscriptions', 'Entrance Fees' and 'Transfer Fees', please read as given below :

Annual subecriptions

Class of Member	Amount
Member	Rs. 80
Associate Member	Rs. 50
Companion	Rs. 100
Affiliate Member	Rs. 50
Graduate	Rs. 40
Student	Rs. 35
Subscriber	Rs. 250

Entrance fees

Class of Member	Amount
Member	Rs. 75
Associate Member	Rs. 60
Companion	Rs. 60
Affiliate Member	Rs. 45
Graduate	Rs. 30
Student	Rs. 15

Transfer fees

Class of Member	Amount
Student to Graduate	Rs. 15
Student to Associate Member	Rs. 60
Graduate to Associate Member	Rs. 60
Associate Member to Member	Rs. 75

instead of what is given in the tables on page xx.

Page 3, line 6, instead of '1963', please read '1962'. Page 45, line 20, instead of '88', please read '78' ; line 22, instead of '1866', please read '1886' ; and line 36, instead of '1880', please read '1900'.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS VACANT,

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P-17, Mission Row Extension

Calcutta 13

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1. **Civil Engineers :** Qualified with 3 to 5 years experience in a drawing office on detailing of heavy industrial reinforced concrete structures. Should be capable of preparing and checking designs and drawings. Corporate membership of recognized institution desirable, but not essential.
2. **Civil Draftsmen :** With a minimum of 5 years experience in reinforced concrete and detailing of heavy industrial structures. Diploma in Civil Engineering or Draftsmanship is desirable, but may be waived in the case of those having more than 8 years experience.

Salary commensurate with qualifications and experience.

Applications, stating age, qualifications and experience, should reach the Company not later than 30th May, 1964.

SITUATIONS WANTED

ENGINEER-ADMINISTRATOR with several years experience in the fields of liaison, research in India and abroad, design and development, management, administration, organization, production and sales. Served on several technical committees of the Government, scientific and industrial bodies, as adviser on selection committees of the Public Service Commission and universities. Held important posts such as Structural and Aerodynamic Engineer, Director (Research and Development), and the office of President of a section in the Indian Science Congress. Acted as leader of a delegation for selection of electronic equipment. Author of several technical papers and reports on technical problems, pilot plants, and special instruments. Member and Fellow of various professional institutions and learned societies in India and abroad. Over 25 years of standing in the profession ; seeks suitable assignment. (Office ref. E.S. 150)

STUDENT of the Institution of Engineers (India), diploma holder in civil and rural engineering, 2½ years experience in planning and supervision, seeks change for betterment ; willing to serve anywhere in India or outside on reasonable terms. (Office ref. E.S. 151)

Statement about ownership and other particulars about the *Journal of the Institution of Engineers (India)*, and the *Bulletin of the Institution of Engineers (India)*, to be published in the first issue every year after the last day of February.

FORM IV

(See Rule 8 of the Registration of Newspapers (Central) Rules, 1956)

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	Nationality	Indian
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6.	Names and addresses of individuals who own the newspaper and partners or shareholders holding more than one per cent of the total capital	The Institution of Engineers (India)

I, B. Seshadri, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date March 1, 1964.

Signature of Publisher

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STATESMAN HOUSE, CALCUTTA.

17 JUN 1964

Published by S. Seshadri, for The Institution of Engineers (India), 8 Gokhale Road, Calcutta, from the same address, and Printed by D. A. Laida at the Statesman Press, Chowringhee Square, Calcutta.

NEW BUILDING FOR THE HEADQUARTERS OF THE INSTITUTION —AN APPEAL TO MEMBERS

Counting the years that have gone by and the progressive years that lie ahead, the Institution has started on an interesting march in the year 1964.

A new project is now on hand to solve a vexing problem—the serious deficit of essential accommodation for carrying out the functions the profession has been demanding—and the grounds of the Headquarters are resounding with the din and clatter of machinery and men. This is the preliminary for a new phase of construction work which is yet to commence—the building of a 9-storey structure (as seen in the artist's impression given below) that is to be the future home for the Headquarters.

An artist's impression of the proposed building for the Headquarters of the Institution

The aim of this new facility is purposeful—to be able to provide efficient service and to add to the prestige and effectiveness of the country's engineering advance as a whole and thus to its cooperative strength.

The architects of the building are Ballardie, Thompson and Matthews of Calcutta, one of India's leading architectural firms and pioneers in this field.

On the evening of Saturday, October 19, 1963, the site wore a festive and colourful look, with distinguished guests, well-wishers and friends bound in goodwill and common allegiance to the faith and values for which the Institution stands; and the function that drew this big crowd was the Foundation Stone Laying Ceremony for the new building.

As a commencement of the schedule that has been laid out for this activity, the first of the 148 Simplex piles (which work has been entrusted to Messrs. Simplex Concrete Piles (India) Private, Ltd.) was struck at 10.40 a.m. on March 4, 1964, on a signal given by Shri Akshoy Bose, Senior Partner of Ballardie, Thompson and Matthews, who was a member of the Council for many years and a former Chairman of the Civil Engineering Division and whose record of service to the Institution over two decades is too well known for recounting here.

The new building will be of nine floors, and space has been carefully planned for the requirements of the various Departments of the Headquarters to meet their immediate and foreseeable needs for the next few years. The total floor area will be made up of: office 26,318 sq. ft., utilities 10,270 sq. ft., and a covered car park on ground floor 3,295 sq. ft. The total height of the building will be 108 ft. 6½ in. The estimated cost of the construction is Rs. 15 lakhs.

The foundation work is expected to commence shortly after the piling work is over, and the entire project is scheduled to be ready for final occupancy by December 1965. The work is in the charge of the Headquarters Building Committee comprising Dr. T. Sen (Chairman), Shri S. Bandopadhyaya (*M.*), Shri J. Dutt (*M.*) and Shri P. Guha (*M.*).

To bring this home into a reality, it has now become necessary for the Institution to engage itself in a major fund-raising venture. The project represents a considerable investment in money and materials. The Institution alone cannot do much to help itself unless its economy regains steam through massive support from the Government, the industries and members. The need for this has never been more urgent, but the will to meet the challenge has rarely been stronger. There is still a long way to go; this perforce is a cooperative endeavour—it compels a pledge to contribute from both within and without the sphere of Institution's influence.

The building can take shape if every member, unified as a whole, makes an individuals gift—to support this significant project which symbolizes the strength and unity of the profession, and stands as a source of pride to those who have helped to build it.

With this note and appeal, the Institution through its Headquarters Building Committee solicits your help and welcomes any financial contribution from you to this Bulding Fund. **YOUR CONTRIBUTION WILL BE GRATEFULLY RECEIVED.**

THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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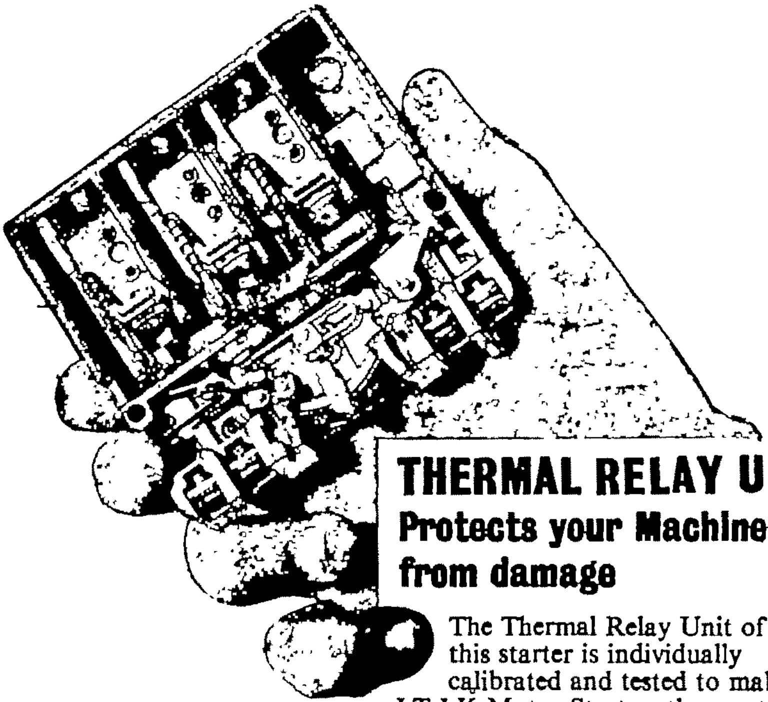

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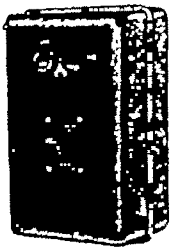

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SOME ASPECTS OF ENGINEERING EDUCATION

Brig. N. Sen Gupta
Member

> *'Upon the education of the people of this country*
> *The fate of this country depends'*
> —Benjamin Disraeli
> in the *House of Commons*

Introduction

The problems of engineering education today are :

(i) The quantum of scientific and technical knowledge which would be of value to a professional engineer has at least doubled during the last twenty-five years.

(ii) The time available for engineering education in colleges has, however, remained virtually unchanged. With the increasing pressure for the of accelerated output of engineers, it is also not possible to prolong the duration of training without seriously affecting the output.

(iii) While, therefore, it becomes imperative that our instructional standards should be high enough to ensure most the effective use of the training time, the wherewithals to reach this standard, seem to be conspicuously lacking. The overall paucity of engineers and the greater lure in other jobs leave but a few suitable candidates for the teaching profession. Unduly large sized lecture classes (which do not lend to personal relationship between the teacher and the taught), ill equipped laboratories and workshops are common to most of our engineering colleges.

Objectives of engineering education

An engineering college cannot possibly impart all the knowledge and experience that an engineer requires. It can only teach the technique of arriving at a particular scientific/technical information and of applying this knowledge in practice. During this training, a student must absorb sufficient information to form a self-energizing nucleus and a firm base for subsequent build-up on his own.

To achieve the goal, training must ferment a student firstly with an aggressive inquisitiveness and secondly with confidence in his own ability to know and learn more. These aspects cannot be incorporated in a syllabus, but should permeate the whole atmosphere of teaching through thoughtful planning and conduct of the courses.

The young engineer today is the manager of tomorrow. For professional excellence, he cannot depend on engineering knowledge alone but his education must be broad-based. He must acquaint himself with the humanities, the arts and the sciences. Only then, he will appreciate the reasons which motivate human society, and so its constituent element 'man' for whom, after all, his efforts are directed and with cooperation only he can bring his plans to a successful conclusion.

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* Presented at the Symposium on 'Some Aspects of Engineering Education' held in the General Engineering Division at the 43rd Annual Convention, Bangalore, May 18-25, 1963

Quality and not mere quantity leads to greater engineering output

Prima facie, a greater output of engineers may be obtained by reducing the curriculum and hence reducing the duration of training. Such a view is fraught with grave danger. Mere numbers without adequate quality cannot yield greater output. Thus, if we could train our engineers to be 50% more effective (which is a possible increase under the existing conditions), it will indirectly add to our 'engineer' strength proportionately.

Of necessity, an engineer learns throughout his life if he is to make the most efficient and economic use of manpower and materials under conditions which present new inventions and discoveries. He cannot afford to remain stagnant but must move with time or still better, move ahead of time. With such restlessness at each level to attain greater efficiency, the in-job training gets an accelerated push and the tempo of engineering work becomes highest.

'A little knowledge is a dangerous thing' and many an organization has learnt this unpleasant truth through bitter experience. A badly trained engineer may not only be a passenger in his organization but may pose a constant problem to his brother engineers in preventing him from doing any work which have to be straightened again. There are more engineers who are not happy with their subordinates, for they lack initiative, drive, practical acumen, and professional knowledge than those who have groused about the quantitative shortfall of engineers in their organizations.

How to achieve quality

Besides good teaching techniques, the quality of the training depends upon :

(i) The calibre and the interest of the instructors ;

(ii) The extent of training aids ; and

(iii) The standards of students.

Instructors

Good education depends primarily on good instructors and very little upon the goodness of buildings. Our immediate task should be to fill the voids within our existing engineering buildings with sound instructors and training equipments. If we invest the money which we may be proposing to spend on constructing engineering colleges/training institutions during Third and Fourth Five Year Plan towards increased pay for our instructors, it is common knowledge that instructors with better calibre would be attracted towards the profession.

Training aids and laboratory equipment

A student learns quicker if he can apply more and more of his five senses (sight, hearing, touch, taste and smell). Thus, theoretically, he should learn almost twice as much during the same period if he can use his two senses to absorb the instructions than only one sense. This usage of training aids to stimulate the senses is, however, seriously neglected. Similarly, the students get very little practical handling due to serious shortage of equipment.

Training aids may include films, roller diagrams, illustrative charts, static and dynamic models (bringing out clearly the principles of the various working mechanisms), sectionized working mechanisms, and so on. A coordinating organization, under the aegis of University Grants Commission may be set up to produce these training aids and every engineering college may be asked to produce training aids on a particular subject. Training aids should be simple and inexpensive. They should be sufficiently self-explanatory to save teacher-time and to cement the class room teaching. In one training institutions, it has been possible to maintain the momentum of training with more than 20% underposting in instructors (subject to a turnover almost every three years) and with 75% overloading of training commitments. The gaps in the training resources has been largely met by self-explanatory training aids, designed and manufactured by the staff and students of the institution.

A very useful and instructive way of getting training aids is through students' projects, seminars, technical papers, and so on. These should be presented by the student/students to the rest of the class/college with the help of adequate training aids to be made by the students themselves. The result is good training aids and fostering a two-way traffic between the teacher and the taught. Besides powers of both verbal and written expression, they also develop the habit of self-study, self-confidence and a sense of originality.

The system of examinations has to be accepted as a necessary evil but it is not to be taken as the only means for assessment. Teamwork in a seminar/symposium or individual effort in writing a technical paper or an individual design/project work must also be considered. Throughout his life, an engineer has to work in cooperation with others and also under stress. The systems of seminars and of examinations fulfil these two requirements, besides bringing out the qualities of original thinking.

Standard of students

The standard of students entering engineering colleges should not be lowered. It is also incumbent that school education, prior to engineering education, should be comprehensive and stimulating. This, unfortunately, is not so and hence, in spite of rigid methods of selection, the basic knowledge of our engineering students is generally poor. They try to memorize too much without understanding, and many suffer from life-long weakness in applying knowledge to practice. All these bring to focus the inadequacy of our school education.

Use of engineers and engineering resources

In view of the acute shortage, it could be assumed that our existing fleet of engineers is being put to the best use. A critical examination will reveal that this is not so.

Many engineers today hold jobs equivalent to those of charge hands and assistant foreman which can normally be handled by diploma holders. One reason for such an anomaly is that our industries are not fully confident of fresh engineering graduates—a point which brings us back to the quality of training.

Secondly, there would appear to be an unbalance between the number of engineering degree holders and deploma holders. In 1947, the ratio was 1:1. In 1961, the ratio became 1:2, whereas in almost all western countries the ratio is 1:3 and sometimes even 1:6. This leads to engineers being used in lieu of diploma holders. Similarly, in a few engineering colleges, we find such subjects as mathematics, thermodynamics and physics being taught by engineers. These subjects could be taught by science graduates, thus relieving engineers for their specific role.

An analysis of the examination results reveals that 31% of the students failed in the B.Sc. (Eng.) examinations and 49% in the B.Sc. examinations (Report of the University Grants Commission, *The Statesman*, December 24, 1962). Science graduates possess a vital potential for engineering activities. These figures indicate a colloseal waste of training effort and is either due to lapse in our selection of engineering/science students or in our training methods.

There would appear to be too many institutions/academic projects which are hardly compatible with our existing engineering resources. There are also several institutions/organizations devoted to similar activities, which could be combined under one roof. Where resources are scanty, concentration of effort is essential for economy and efficiency even under normal conditions. Only when an organization becomes too unwieldy for ease of control and working, a new organization may be instituted to round off the bulging corners. We seem to be going the wrong way round in most cases, with the result that we have too many outer shells of organizations with a considerable vacuum therein.

And finally, we come to the practical training of an engineer where we are not making use of the existing potential of our industries fully. In most industries, practical training is left to chance. In the absence of guided training, the student often feels frustrated and his time is wasted. Our industries should appreciate that trained engineers are as vital to their progress as any vital raw material and they should take a corresponding interest in their training.

How to increase output

Irrespective of what has been said before to offset the shortage of engineers, there still remains a vastly growing requirement for more and more engineers. Following suggestions are made for increase in the turnover of engineering students :

(i) Reduced course for B.Sc. graduates ;
(ii) Reduced course for diploma holders ; and
(iii) More evening classes.

B.Sc. graduates

The science graduates should be able to come up to the engineering degree standard in a comparatively shorter time than the normal entry from the school. A reduced course of 3 years should be adequate for selected science graduates and this should be devised.

Diploma holders

The present syllabus of the diploma holders contain a fair proportion of syllabus of the engineering degree. Selected diploma holders should be able to come up to the engineering degree standard within a period of two years through organized day time classes or within three years through evening classes.

Evening classes

Evening classes should be considered as part of the integrated system to produce more engineers and not be left to private agencies or be considered as *ad hoc* arrangements. Selection to evening classes should be strictly controlled, so that training effort is not wasted. Evening classes should not only be organized in our universities and polytechnics but also in our major industrial enterprises.

Reorganization of technical education in emergency

Because of the nature of work of the engineer, his training has to be broad-based. This, however, does not equally apply to tradesmen or diploma holders whose sphere of acivity is comparatively restricted. Particularly for the present emergency tradesmen can be more specialized. A welder, for example, can either be trained in gas welding or in electric welding. Similarly, we do not want an universal machinist. Let us instead, have a lathe man, milling machine man, and so on. Similarly, the more skilled types of tradesmen, say, vehicle mechanics, telecommunication mechanics, instrument mechanics, etc., need not learn the whole of their profession at one stretch. He should come back for periodic refresher courses both to refresh and to add on to his knowledge. The incentive may be further promotion or pay increase. This is the practice in the army and it pays rich dividends. Similarly, there is a case for further subdivision of diploma courses and also for pruning the syllabus.

Summary of recommendations

We must take an immediate stock of the engineering education in our country with a view to remedy the existing defects. For speed and objectivity, a committe of only four responsible engineers (who have been actively connected with teaching) should be appointed. It would be preferable if they also had been connected with industry at some stage of their career. The time allotted for the study should not exceed three months. The Chairman of the Committee can coordinate the work of three members dealing with the respective problems of engineering degrees, diploma training, and trades training. The committee should be set up by University Grants Commission so that it is vested with necessary authority. Their terms of reference should include :

(i) Whether the engineers or diploma holders are being properly employed in training, research, or industrial establishments? If not, why? What are the recommendations to remedy the situation?

(ii) The actual requirements of engineers on the basis that engineers are properly employed.

(iii) Is there any avoidable dispersion of effort in the matter of research or training establishments? Can this be reduced to ensure that the knowledge of an engineer can be concentrated to more cohesive purpose?

(iv) How to improve the quality of teaching? Suggestions for the preparation of training aids and allotment of work to prepare training aids to various engineering colleges.

(v) How to reduce teacher-time by introduction of suitable self-explanatory training aids, simple engineering text-books and so on?

(vi) Is practical training in industry for engineering students effective? If not, how to make it effective?

(vii) Is there a case for pruning of syallabus for diploma holders? If so, how should one approach it?

(viii) Is there a case for further sub-division in engineering diploma courses? If so, what are the recommendation?

(ix) Owing to present emergency, is there a case for narrowing down the trade specializations. If so, how?

(x) How to maintain and ensure a dynamic progress on the continued improvement in quality and quantity of engineering education in the country? Is a small coordination cell permanently necessary? If so what should be its set-up and charter of duties?

Simultaneously, with the above investigations University Grants Commission may initiate action on the following :

(i) A method for assessing engineering student which will take into account not only his examination results but also his class work including seminar work, technical paper, design project, design and manufacture of training aids.

(ii) No new buildings for training should be constructed until the present buildings are adequately staffed and equipped.

(iii) Maximum advantage be taken of the residuary capacity of instructors (with part-time honorariums), buildings and equipments for conducting part-time evening classes.

(iv) The ratio of engineering degree holders to diploma holders should be lowered down to 1:4.

(v) A reduced syllabus of engineering degree for science graduates (3 years) and diploma holders (2 years) should be introduced.

(vi) A syllabus should be framed for a 3 years course for part-time evening classes for diploma holders intending to appear for the Associate Membership examination of the Institution of Engineers (India).

(vii) A long-term policy should be framed for improvement of school education.

Conclusion

Upon engineers rest the material prosperity of a nation. Their training can, therefore, be neglected only at our own peril. There is no short cut to engineering education. We can however reduce the non-productive element and make training more interesting, so that students are enthused to learn on their own. Such learning, prompted by the teacher as if it is through the student's effort, will bear the strain of professional pressure when these students become the engineers of tomorrow.

It must be clearly understood that training for engineering or for any profession, starts from school days. It is in these formative years that a young boy begins to appreciate knowledge for the sake of knowledge, and works up a continuing thirst for it. He develops a commonsense in deriving fresh knowledge for himself and a practical aptitude for putting knowledge into practice. The education at school is the foundation for any profession and so we dare not continue neglecting it.

SOME ASPECTS OF ENGINEERING EDUCATION*

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1. Introduction

Engineering education is vital to the future progress of this country, both for peacetime activities, as well as, for efforts to strengthen the defence of our country. It is to this Institution that the authorities in charge of planning and education look for appraisal of the standards and programmes of engineering training from time to time. Besides, the Institution is also playing its part through its examinations to help produce engineers to push through the projects envisaged in our successive development plans.

2. Do we need more engineering colleges ?

This is one of those questions which would get a 'Yes' answer for many years to come. With the enormous pace of development of science and technology, at no time we can expect their large scale application through engineering efforts catching up with the development, thereby, always leaving a lee-way for having more engineers. In this connection, the facts and figures of some of the most highly developed countries merit our attention.

In an article, entitled 'A Goal for American Engineering Education', Solomon C. Hollister stated, in 1952, that against an annual requirement of 80,000 graduate engineers in the U.S.A., the output of engineering graduates for the year 1952 and for many years there of, did not exceed 20,000, and a shortage of engineer was constantly being faced. It was also observed by him that, whereas in 1890, when there was one engineer for every 300 workmen employed in an industry, today, due to rapidly accelerating technological development, there is one engineer to approximately 50 workmen. At the same time, it was also noted that this increase was not likely to continue as, the number of freshmen normally entering engineering colleges, had more or less stabilised as a fixed percentage of the population, and the present percentage is virtually at saturation point. Therefore, there is the problem of an increasing demand of engineers, with relatively lower outturn of engineers from year to year, to meet the same. One suggestion to offset this position has been the need for a revision of objectives in engineering education and possible reorganisation of the provisional functions and the revision of engineering curricula. Another opinion that had been held is that, in spite of the fact that intelligence and desire to serve are equally essential factors in professional activity, adequacy of compensation will mostly determine the field which the prospective student will choose to direct his talents. It is, therefore, obvious that unless the magnet of attractive compensation is adopted to draw men to a particular field, whether it is professional or non-professional, its needs in numbers can never be satisfactorily met. With particular reference to the position of civil

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* Presented at the Symposium on 'Some Aspects of Engineering Education' held in the General Engineering Division at the 43rd Annual Convention, Bangalore, March 18-25, 1963.

Table 1

Enrolment trend in the universities

Country and Year	Total No. of Students	Humanities	Education	Fine Arts	Law	Social Sciences	Natural Sciences	Engg.	Medicine	Agriculture	Others
Canada (1958)	92,560	33,396 (36.1)*	7,701 (8.3)	920 (1.0)	2,714 (2.9)	8,720 (9.4)	12,071 (13.0)	14,826 (16.0)	8,941 (9.7)	2,738 (3.0)	530
U.S.A. (1958)	3,236,414	—	—	—	—	—	—	287,164 (8.90)	—	—	—
Japan (1958)	636,232	95,659 (15.0)	69,681 (11.0)	10,079 (15.8)	65,019 (10.2)	218,214 (34.3)	26,475 (4.2)	83,584 (13.1)	38,225 (6.0)	27,893 (4.4)	1,403
France (1958)	226,173	57,263 (25.3)	1,367 (0.6)	4,144 (1.8)	34,229 (15.1)	3,010 (1.3)	61,725 (27.3)	15,755 (27.3)	41,182 (18.2)	2,210 (1.0)	5,288
Germany (1958)	164,015	37,692 (23.0)	463 (0.3)	5,346 (3.3)	18,996 (11.6)	20,101 (12.3)	23,310 (14.2)	30,923 (18.9)	23,797 (14.5)	3,322 (2.0)	65
U.K. (1958)	111,437	34,221 (30.7)	2,230 (2.0)	225 (0.2)	4,024 (3.6)	6,524 (5.9)	24,185 (21.7)	10,739 (5.6)	17,374 (15.6)	2,378 (2.1)	9
U.S.S.R. (1959)	2,260,400	—	733,000 (32.4)	18,500 (0.8)	154,400 (6.8)	145,700 (6.4)	—	756,000 (33.8)	184,600 (8.2)	259,200 (11.5)	—
India (1957)	833,450	433,104 (51.8)	19,044 (2.3)	3,292 (0.4)	22,695 (2.7)	63,358 (7.6)	218,418 (6.2)	28,340 (3.4)	344,771 (4.1)	9,596 (1.2)	2,13

* Figures in brackets give the percentage

engineers, it has been stated that in an American city with a population of 16,500, twenty-nine new graduates are added each year, whereas, it adds one civil engineer to its numbers every two and a half years. Of the people residing in the city it is found that against ten civil engineers, there would be twenty-two doctors and thirty-three practising attorneys.

Even in the U.K., measures had been taken to increase the supply of engineering graduates from 9,000 in 1955-56 to 15,000 by 1960-61. A more serious situation is to be faced in this country. Table 1 gives the enrolment trends in the universities of some selected countries of the world, from which, the position of India *vis-à-vis* other countries can be seen. A comparison by numbers, as also by percentages, will reveal that India is, by far, the last country in its relative draw of students to engineering. The importance of each country, industrially, amongst various nations, can also be judged from a study of these figures.

The fact that these are not lost sight of by our Government, can be seen from the data on the existing and proposed provisions for training in the degree and diploma courses in engineering for the period 1950 to 1966, given in Table 2*.

Table 2

Provisions for training in degree and diploma courses in engineering*

Year	Degree Courses			Diploma Courses		
	No. of Institutions	Admission Capacity	Out-turn	No. of Institutions	Admissions Capacity	Out-turn
1950-51	49	4,120	2,200	86	5,900	2,480
1955-56	65	5,890	4,020	114	10,480	4,500
1960-61	100	13,860	5,700	196	25,570	8,000
1965-66	117	19,140	12,000	263	37,390	19,000

Note :—

(i) In addition, part-time and correspondence courses in different branches of engineering and technology, suited to the needs of age groups of 20 to 35, are being arranged ;

(ii) Pilot schemes on a part-time basis for 1,000 diploma holders in engineering at 12 centres under the Ministry of Defence, to qualify for Sections A and B of the A.M.I.E. examination, are in progress; and

(iii) Sandwich courses in mechanical engineering started at Calcutta and Madras in the Second Plan, to be extended to other fields and also to be organised at other centres.

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* 'Third Five Year Plan.' Published by the Planning Commission, Government of India, p. 615.

Also, that there is a gradual increase in the enrolment percentage in engineering, can be seen in Table 3.

Table 3

The extent of expansion of various faculties of the universities in recent years

Faculty	Enrolment in lakhs 1956-57	Percentage	Enrolment in lakhs 1960-61	Percentage
Arts ..	3.96	51.5	4.49	44.9
Science ..	2.10	27.3	3.00	30.0
Commerce ..	0.67	8.7	1.02	10.2
Engineering and Technology ..	0.21	2.7	0.36	3.6
Medicine ..	0.23	3.0	0.27	2.7
Veterinary Science ..	0.04	0.5	0.05	0.5
Education ..	0.13	1.7	0.15	1.5
Law ..	0.20	2.6	0.23	2.3
Agriculture ..	0.10	1.3	0.13	1.3
Others ..	0.05	0.7	0.30	3.0
Total ..	7.69	100.0	10.00	100.00

The number of engineering colleges needed for the outturn of 12,000 graduates is 117, out of which, 40 are yet to be started. This gives an average of 100 students per college per year, and based on this average, the number of colleges appears to be adequate, provided the facilities and the teaching staff of appropriate qualifications are simultaneously made available. In regard to the latter, the following six measures are envisaged :

(i) Teacher training programmes within the country and abroad, begun in the second five-year plan are extended ;

(ii) Pay-scales and general service conditions of the teachers are steadily improved ;

(iii) Schemes of advance recruitment of teachers and creation of supernumerary posts in the teaching staff of the institutions are enlarged ;

(iv) Large number of persons with specialised and research qualifications will come up with the development of post-graduate studies in engineering and technology ;

(v) Enlisting of the help of industry to obtain the services of practising engineers and executives as part time teachers ; and

(vi) Arrangement of refresher courses and seminars to raise the quality of teaching at every level.

Because of the wide scatter of our institutions, it is doubtful whether the services of practising engineers and executives as part time teachers would substantially help in solving this problem. The adequacy of the colleges would also have to be considered from the point of view of teacher-student relationship and unless the strength of each class is reduced, say to about 30, each student may not get the attention required. At present, in view of the shortage of teaching staff, the closs strength average is much high. As planning of various activities cannot be satisfactorily done by mere subdivision of a class within the same institution, the resources to develop each institution so as to reduce the number of students in each class would be a desirable step.

3. Fits and misfits

This subject requires consideration from three aspects :

(i) Mental capacity of the student to acquire the required proficiency academically ;

(ii) Physical fitness is essential for pursuing the profession which involves arduous tasks requiring endurance and strength ; and

(iii) Qualities of good character, conduct, and other general attainments like clarity of expression, etc., which are vital to the success of the engineer in directing various jobs and also, for maintaining the position of leadership in the service of the community.

With the selective basis of admission to our engineering colleges, for which competition is growing keener year by year, there is no doubt that every one of the selected students generally satisfy the first two aspects, *viz.*, academic proficiency and physical fitness. It is only in respect of the third aspect, *viz.*, character, conduct, etc., that a single check at the time of selection is not sufficient. It is learnt, that in Japan where the competition for entrance to the universities is stiff, involving a written examination and physical test, there is also insistence on the recommendation of the students from the principals of the schools about the suitability of their qualities for the vocations. A procedure of this nature helps in the development of loyalty from an earlier age which comes in very handy in building up the individual for his future career.

With a guarantee of adequate measures in the selection of students, the possibility of misfits arising during the course of study in the engineering college is remote, and if at all there are any, they can be corrected by periodical checks of the staff or by some other alternative measures.

The increasing recognition of the idea that sound knowledge of fundamentals of mathematics and the sciences should form the basis of technical training has been responsible for the starting of the pre-professional course for one year in the professional colleges. This is in addition to the four-year course for engineering. This 5-year integrated course, which is now insisted upon, will to a further extent eliminate any possibility of deficiencies in the academic requirements, and also, will bring out misfits during the course of study. If, lower class strength permitting better supervision of students by the teaching staff, is created, soon all the selected candidates will acquire the proficiency required to qualify as engineers and the necessity of many students having to repeat years in the classes will be obviated.

The standards of physical fitness are also on the increase due to the well organised plans of the university training corps, auxiliary cadet corps, and the compulsory sports activities, made possible by liberal allotment of money after the independence and there is little likelihood of any misfit coming out except from the causes of rare ailments.

4. Desirability of assessment of term-work in engineering examinations

An examination of this subject needs a pre-view of re-orientation that is taking place in the study of engineering. All the world over, there has been an increasing emphasis on the study of the basic sciences, the engineering sciences, the humanities and the social sciences, accompanied by de-emphasis on the engineering arts and practice in the curriculum of engineering graduate. This is effected by the elimination or reduction of the time allotted to the courses which have a vocational or skill content. The objectives behind, such re-orientation are, firstly, for the engineering education to keep pace with the rapid advances that are taking place in the sciences and secondly, to provide the future generation with engineering leaders having the capacity to apply new scientific discoveries in a creative manner.

Term-work has two objectives :

(i) Enforcing alertness and devotion of the student in the study of the subjects ; and

(ii) Where skills and arts are involved, to help perfecting the same through compulsory practice.

In regard to the first objective, the means of assessing the term-work pertain to the process of understanding the subjects of the basic and the engineering sciences and, they are in the form of either exercises involving problem and their solutions or through periodical tests. Since, it is essential that the knowledge of the student would have to be grossed up for advanced study, the proportion of credit or marks gained during the term should form a relatively small fraction of the total required, both from the term-work and the final examinations.

In regard to the engineering, other skills and art, such as, laboratory and workshop work, field work, and drawings, which do not permit of a comprehensive assessment of skill and perfection in one examination, the weightage or proportion of term-work relative to the marks obtained in the final examination, should be large enough to influence the qualifying requirements of the student. In this latter aspect, the examination serves only to test the capacity of the student to regain his skills under a condition of surprise rather than, as an opportunity of revealing his complete potential.

Therefore, in general there appears to be an essential need for assessment of term-work in engineering education. The quantum of assessment of term-work contributing to the qualifying requirement of the student depend on the extent of engineering arts and practices including the curricular study. Another factor contributing to the satisfactory assessment of term-work is the quality and the number of supervisors available who can adopt a rating method effectively and uniformly.

5. Re-orientation of technical education in national emergency

This subject has a bearing both on the short-term and long-term measures that are required, to meet the demands of engineering graduates in the defence services. The immediate need is the balancing of local effort with adequate foreign aid and thereafter, a gradual switch-over towards meeting the full demands locally for the defence. During the convocation address at the Roorkee University, this year our past-President, Dr. A. N. Khosla, has dwelt at length on the quality of engineering graduates qualifying from the colleges at present, and also on the need for luring our engineers with a creative talent to compete with the developments in the various fields of engineering in other countries. A few observations on the aspect of civil engineering training may be mentioned as a supplement.

A close look at the nature of civil engineering activities necessitated by exigencies of war, clearly point to the fact that the types of skills necessary are not those pertaining to any special changes required in the basic engineering sciences, and thus, by way of curriculum no gross changes are necessitated. Attainments are more in the art and skill of military engineering methods which have to follow the graduate training through programmes of in-service training. Since the academic level of military engineers as such would have to be fairly high, the prospect of condensing the course of study, which is already on a tight schedule, is not also desirable. Shortfalls in the number of engineering personnel, should be made good by creating a second rank of sub-professional engineering aids, whose course of training may be limited to the activities which are to be immediately tackled.

Since, no basic change is called for in the course of training of civil engineers to form the group for further training of military engineers, even on a long-term basis, re-orientation of engineering study in the colleges is not necessary. However, the right step is to encourage formation of a corps of engineers in the army, of large strength even in peacetime. After getting adequate military engineering training, they may be usefully employed in the various construction projects, etc., working within an organisation similar to the U.S. army corps of engineers. Such reserve of engineers can be switched over from peacetime activities to emergency duty, as and when required, without creating a big gap between demand and supply. On a long-term basis, there is also the need for a large number of highly qualified professional engineers and there appears to be no short-cut for achieving this except through intensification of the post-graduate training programmes in the colleges. There is also a need for some measures to check that the post-graduate programmes are encouraged only where faculty and other facilities permit.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Delhi Centre

Chairman's address by Shri D. C. Baijal, B.Sc., C.E., I.R.S.E., M.I.E., at the 37th Annual General Meeting of the Centre on January 16, 1964.

The Chairman welcomed the Chief Guest, Shri C. Subramaniam, the Union Minister for Steel, Mines and Heavy Engineering, and other invitees, and thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering his address, Shri Baijal said 'This Institution of ours is now in its 44th year of existence. From modest beginnings it has grown with the times and is today an embodiment of the highly diversified profession that engineering has become in this age of rapid technological advance. It is a matter of deep gratification and pride to us that three of our past-Presidents have successively risen to positions where their voices can be effectively heard in the counsels that direct our developing economy. We hope that more and more of our engineers will be placed in key positions in various establishments in the country.

In the successive Five Year Plans that we have embarked on, the tasks of the engineer have increased considerably in magnitude and complexity. Nearly 60% of the provision for the Third Plan relates to irrigation, power, industries, transport and communications, for which the engineers have to shoulder the responsibilities of execution and implementation. It is an opportunity and a challenge that in the building of a new India, the India of our dreams, the Engineer has a unique role to play in planning and building up the sinews of development and prosperity. I would refer briefly to some of the important technological changes that are taking place on the Indian railway scene and the directions in which emphasis is likely to shift in the coming years.

It is an axiomatic truth that a first rate transport system is a *sine qua non* of industrial expansion and economic growth. The railways constitute the major transport system in the country and as such they have to play a very important role in the industrial revolution that is convulsing the length and breadth of our country. Since the ushering in of the Plan era, the traffic on the railways has been increasing at a very rapid rate. Between 1950-51, the first year of the First Five Year Plan, and 1962-63, the second year of the Third Plan, the originating goods traffic on Indian railways rose from 93 million metric tonnes to 170 million metric tonnes. while the passenger traffic during the same period rose from 1,284 million passengers to 1,749 million passengers. In 1962-63, the railways carried 18.3 million tonnes of additional originating freight traffic over the level of 1961-62. This was the highest increase in freight traffic handled so far on Indian railways in any one year. In the current year we hope to fully realise the anticipated increase of 17.27 million tonnes of additional traffic, over the figure of 1962-63. By the end of the Third Plan, the originating goods traffic is expected to reach 245 million tonnes. In other words, within 15 years the traffic is likely to increase by more than 150%.

The railway system inherited by us at the time of independence has had to be expanded and improved a great deal to cope with the new dimensions of a new age. In this process, which is still continuing, the engineer has had a very important role to play in the schemes to augment capacity to meet the ever increasing traffic demands. The most outstanding technological development in the railway world in the last decade and a half has been the displacement of the steam locomotive by diesel and electric traction. In the U S.A. and Canada, the change-over to diesel locomotives of the electric-transmission type was almost dramatically swift and the steam locomotive has completely disappeared on the North American continent. Though electric traction has its advocates there, it has made little or no headway except in minor extensions of suburban services in certain areas. Sporadic attempts at developing an efficient coal burning gas-turbine locomotive have not been successful and only one 7,000 H.P. experimental unit is on trial. In Western Europe, particularly Germany, the evolution of a satisfactory hydraulic transmission for medium to high-speed high output engines stimulated the pace of main line diesel locomotive applications. Until then, the use of diesel engines on railways was largely in low horse power shunting locomotives and rail cars. The major break-through in electric traction, pioneered in France, was the adoption of the 25 kVA 50 cycle A.C. system at industrial frequency for railway electrification. After satisfactory answers were found to allay initial misgivings on questions of phase balance and interference in telecommunication circuits, it did not take long to establish the superiority of direct utilization of power at industrial frequency over the 1,500 or 3,000 volt D.C. system. By bringing high voltage A.C. current right up to the catenary and pantograph of the locomotive, substantial savings in the first cost of substations and overhead equipment were effected. Experience showed the operating costs to be lower too. Electrification and dieselization of the railway systems of Europe and Russia are now going forward rapidly, both complementary to one another and all aimed at replacing steam traction in the shortest possible time. In West Germany the policy appears to be to electrify ultimately all main lines and relegate diesel traction gradually to branch lines.

To handle effectively and economically the fast increasing freight and passenger traffic on the Indian railways, it became necessary to modernize railway equipment including rolling stock, as also the introduction of new modes of traction, namely dieselisation and electrification. Owing to the limited availability of foreign exchange resources and the fact that electric and diesel locomotives had to be imported, a modest programme of electrification and dieselisation was proposed in the first instance. It was also decided that to conserve foreign exchange, indigenous facilities should be set up for manufacture of diesel and electric locomotives. Chittaranjan Locomotive Works, which had hitherto been producing steam locomotives only, was selected for the production of electric locomotives in addition. Most of you would be aware that these works, after completing manufacture of 21 D.C. electric locomotives for the Bombay area, took up manufacture of A.C. locomotives for Railways in the coal and steel belt, and the first A.C. locomotive was commissioned by our respected Prime Minister about two months ago. For the manufacture of diesel locomotives, it was decided that facilities should be developed at Varanasi and the first locomotive from this factory was commissioned in the beginning of this month by Shri Lal Bahadur Shastri. The indigenous manufacture of electric and diesel locomotives shall considerably help the Indian railways in meeting the demands of ever increasing traffic being generated in the wake of industrialisation.

During the Second Plan, main line diesel traction for carrying through freight services was introduced as a prelude to electrification on the congested routes of the Eastern and South Eastern Railways. This was necessary to cope with the rapid build-up of traffic which was beyond the capacity of steam traction during the period when the electrification projects were being executed. In the Third Plan, the concept of long distance haulage by diesel traction of the heavy freight trains, particularly those carrying coal and ore and some long haul general goods, has been extended to serveral important routes which were fast aproaching conditions of saturation with steam traction. Apart from the fact that electric traction requires a certain minimum intensity of traffic to justify it financially, the extent of electrification that can be programmed in any one Plan period is conditioned by limitations of finance, including foreign exchange resources, availability of electric power, equipment and capacity for execution of electrification works.

During the Second Plan, considerable thought was given to the type of broad gauge main line diesel locomotives for operation on the congested routes which called for diesel traction as a precursor to electrification. It was finally decided to procure 100 B. G. main line 1800-1950 H.P. Alco diesel-electric locomotives of the world series from the U.S.A. These locomotives have been in service for the last 5 to 6 years on the Eastern and South Eastern Railways. Most of the sections where these locomotives were originally used to haul through coal and ore trains have since been electrified and the diesels have been transferred to other sections where the impact of the Third Plan traffic had indicated the replacement of steam traction. The use of these locomotives on these sections has greatly helped the Eastern and South Eastern Railways in clearing the coal and other steel plant traffic over sections where it would have been almost impossible to do so with steam traction.

During the Third Plan it is proposed to introduce dieselisation on about 8,000 km. on the broad and metre gauges. Our experience in diesel traction on the main lines has indicated that further acquisition of main line locomotives with electric transmission should be of higher horse power namely 2400-2600 for the broad gauge and 1250-1300 for the metre gauge.

Programmes relating to electrification have also made good progress. During the Second Five Year Plan, 361 route km. (1030 track km. of main line were brought under electric traction and during the first two years of the Third Five Year Plan, 860 route km. (1,880 track km.) have been electrified. At the moment, work on 285 route km. is in advance stage of progress. Initially 110 electric locomotives for mixed traffic of 2840 H.P. capable of running upto a maximum speed of 112 km. per hr.

were procured. The subsequent addition to the fleet has been in terms of FT type of locomotives for freight traffic of 3200 H.P. These locomotives are capable of hauling goods trains of 3660 tons on flat sections and moderately graded sections upto 1 in 200 at maximum speed of 85 km. per hr.

With the increasing availability of electric power, the setting up of oil refineries in the country, and the indigenous production of electric and diesel locomotives, the pace of replacement of steam locomotives by electric and diesel traction will be greatly accelerated in the Fourth Plan. It is hoped that during the current Plan, 113 diesel locomotives and 129 electric locomotives will be manufactured in the Railway Ministry's production units at Varanasi and Chittaranjan.

Together with electrically or electro-pneumatically operated point machines (and wagon retarders), the application of sensitive and reliable electrical relays has opened up a new vista of sophisticated means of railway operation. The effect of this has been felt in various directions like partial or full automation of trains reception and despatch at important junctions, humping-operations in major marshalling yards, and eventually in the remote control of train operation from a central point over a hundred route miles or more of territory. The consequences of these advances in signalling and train control technology are enlarging the capacity of railway installations for handling trains and wagons at relatively low capital cost. These are technically comparable in many ways to the revolutionary changes in miniaturising of electronic equipment that the invention of the transistor brought about. There are already indications that electronic devices are taking over the functions of relays in the more intricate track circuit systems being developed on the pattern and principles of computor design.

On the Indian railways, although automatic colour light signalling has been in use on the electrified suburban sections of the Bombay region for over 30 years, the mechanical signalling and interlocking system, supplemented as necessary by simple electric detection devices and partial track circuits at stations on important high traffic density routes has, generally speaking, been found to be adequate. Considerable improvements in types and standards of mechanical signalling have been carried out all over the country to meet the more exacting needs of increasing traffic density. We are now completely self-sufficient in indigenous production of mechanical signalling equipment. And this achievement of Indian industry has been of immense value in assisting our railways in fulfilling the commitment of the Second and the Third Plans.

On the electrified routes, the colour light signal is fast replacing the semaphore arm. At important junction stations, where traffic growth is reaching proportions beyond the capacity of basically mechanical appliances, route relay interlocking is taking over. Such installations are already functioning at Madras Central, and Kurla and Churchgate stations in the Bombay area and have been projected at Howrah and Delhi in the Third Plan. Automatic colour light signalling is being extended on some highly congested double line sections of the South Eastern and Eastern Railways and in the vicinity of Madras. The first centralised traffic control installation on a single line trunk route has been planned on the North Eastern Railway. Moghalsarai, the biggest marshalling yard in the country and handling nearly 6000 wagons a day, has been equipped with electro pneumatic retarders. Mechanisation of the humping operation in the yards at

Bhilai, Rourkela, Tatanagar, Waltair and New Katni will follow. There is little doubt that, in the Fourth and subsequent Plans, the need for electrical signalling and train handling equipment will grow as traffic densities become more concentrated on vital double line routes and focal points of railway operation. To beck up this effort and reduce our dependence in a field that is largely import-oriented indigenous industry and know how will naturally have to be progressively developed in this direction.

The railways indeed typify the strenuous efforts in the country to conserve foreign exchange and develop indigenous sources for our requirements in various fields. The railways require large supplies of stores and equipment ranging from textiles, hardware, paints and oil to locomotives, other rolling stock, machinery and plant, cranes, track materials, structural steel, etc. In the first few years after independence, nearly 25% of the total purchases made by the railways were in the form of imports. But through a carefully designed scheme to foster indigenous production, they have brought down their imports appreciably inspite of the larger outlays required on electrification, dieselisation and other such measures. Out of the total stores purchases in 1962-63 which were of the order of Rs. 267 crores, as much as Rs. 229 crores worth were from indigenous sources. The fillip to indigenous industry and new fields of engineering practice as a result is obvious.

I am making a special mention of this because the engineer in India, unlike his counterparts in advanced countries, has all the time to contend with the peculiar problems of foreign exchange availability never matching the demands and the consequent need for ingenuity and enterprise in developing indigenous production. The example of the Indian railways in this respect is perhaps a notable one.

In their mid-term appraisal of the Third Plan, the Planning Commission have stated that there has been significant improvement in the transport situation over the past two years. Improvement in coal transport position has been particularly marked since November 1962, and loadings from almost all the coalfields have exceeded the targets, which were set for the railways for this period. These improvements in the transportation situation have taken place notwithstanding the heavy burden that was placed on the country's transport system, and more especially the railways, by the emergency which began in the latter half of 1962-63. It is a matter of gratification that the railways have lived up to the expectations of the planners and are fully geared to carry the burdens, which they will have to shoulder in future.

The success which the railways have achieved is due in a large measure to the proper planning, timely and expeditious execution of the various schemes for augmenting the transport capacity, and full coordination between the various departments responsible for different aspects of working of the railways. Railways have a large number of engineers, civil, mechanical, electrical, signalling, and telecommunication, mining, Metallurgical, etc., and they have all to work together, each one doing his bit towards bringing about improvement in the overall performance of the railways. What applies to the railways applies equally to other industries and points to the imperative need for proper coordination between the various wings of engineering and technology so as to secure the most fruitful results in a period like this when large-scale developments are taking place. We cannot work in separate spheres or cubicles, pre-occupied only with the particular branch of engineering which happens to be our individual calling. There has to be a pooling of efforts, an interchange of knowledge and techniques among the various forms of engineering. Fortunately, the Institution is itself a good example for the promotion of such co-ordinated endeavours, presenting as it does a good forum for benefiting from each other's work and experience.

I shall now conclude with one or two general observations. Engineers would do well to take a greater interest in the environment in which they function and learn to absorb the new techniques management is drawing to its aid: work-study, costing and cost accounting systems and methods of analysis, planning and programming of operations. Despite the great strides already taken, we still have a long way to go to build up an industrial structure adequate for the county's needs. There is also the need for research not only for the maintenance of quality and improvement in the products of engineering and industry but also to assist us in keeping abreast of the developments in other parts of the world. In all these tasks the role of the engineer is not only important but continues to grow in dimensions. Let us pledge ourselves anew to dedicate ourselves to our great responsibilities'.

Gujarat Centre.

Chairman's address by Shri Manibhai M. Patel, B.E., M.I.E., at the 4th Annual General Meeting of the Centre on December 15, 1963.

The Chairman welcomed the Chief Guest, Shri Balawantrai Mehta, Chief Minister of Gujarat, and other invitees, and thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering his address, Shri Patel said 'It is only by joining this Institution that an engineer can hope to keep his technical knowledge at a higher level throughout his professional career and also assist his fellow engineers by imparting to them his own experience through technical papers and articles. The Institution has provided a universal forum to have within its fold engineers from all different branches of engineering. To accelerate the activities of the Institution for this centre, it is absolutely necessary to have its own premises with full accommodation for each of the activities. We shall be very highly obliged if our Chief Minister will help our centre by allotting a land of suitable size and by allowing a substantial grant for construction of its own building. Another more important necessity for the growth of our centre is to have a good technical library. It must be an effort of all of us to establish a fully equipped technical library at Ahmedabad and also at other important cities in our state. I hope assistance will be forthcoming from our State Government as well for building up the library of our centre. It is also our earnest desire to encourage publication of articles by engineers. Conventions must be developed, by which deserving young engineers are encouraged to contribute freely their ideas and suggestions and which must be duly recognised by award of prizes or rise in salary. Engineering profession must also necessarily be publicized widely as a career. Liberal aid should be extended for the engineering students in order to attract best brains in the country to our profession.

Gujarat has still remains a deficit state, in all items required for the progress of the community. I will only try to discuss the salient points here.

First comes our road system. Its inadequacy and the extremely poor condition of the mileage are well known. The National Highways in the State as defined by the chief engineers who drafted the Nagpur Plan of 1943, as the apex of the arterial system designed to link important centres, are dotted with missing links. Only a very short length has two-lane carriage way. Our backwardness in the matter of roads can be appreciated well from the figures of our road mileage per 100 sq. miles compared to that of other nations for the some area. While Japan and the United Kingdom have reached the figures of 418 and 219 miles of surfaced roads, we in India have hardly reached a figure of 12 miles of surfaced roads and 35 miles of all category roads. The paucity of roads is reflected in the fact that thousands of our villages lie in isolation. The findings of the National Sample Survey show that 25% of our villages lie from 3 to 5 miles from a metalled road, and more than 36% at a distance of 6 miles and over. How can we expect the benefits of our plans and scientific advancement to percolate down to the people, when most of them remain in such isolation? Existing road mileage in Gujarat, which is now developing as an industrial state is also, very low, even when compared to that in most of the other states of India. The number of our State in road mileage per 100 sq. miles of the area is 12 out of a total of 15. While West Bengal, Kerala and Bihar have 119, 82 and 75 miles of roads for every 100 sq. miles, Gujarat has only 27 miles. Similarly, our State bears the number 13 out of the same total of 15 for mileage of roads per lakh of population. Mysore, Assam and Rajasthan have 166, 153 and 127 miles of roads per lakh of population, while we in Gujarat have hardly 74 miles. Nagpur Plan targets of road construction have been attained in India as a whole and in most of the other states of the country. We had in Gujarat 8,169 miles of roads in the beginning of the First Five Year Plan, while the target as per Nagpur Plan was 24,315 miles. We have 11,048 and 14,481 miles of roads at the end of the First and the Second Five Year Plans, respectively. We are thus 41% behind Nagpur Plan. The State will have 17,181 miles of roads at the end of Third Five Year Plan period and will still be 30% behind the Nagpur Plan targets. The new Twenty Year Road Development Plan has been prepared for the years 1961-81, and is already taken in hand in other states. According to this plan, as prepared by the Government of Gujarat, the present length of 14,481 miles of roads in the State is proposed to be extended to 36,000 at the end of the plan period, *i.e.*, by 1981.

There has been very little progress about laying of new railway tracks in our state. The work of Himatnagar-Udaipur meter gauge line is in progress. It is expected that Himatnagar-Shamalaji section of the new line may be put to use during the next year. The very strong demand of the people of this state to provide immediately a broad gauge link between Viramgam and Kandla remains unheard of so far. The Railway Board authorities have recently moved out only to suggest probable alternative routes to this line. Our past experience has shown that such suggestions have simply created controversies in the matter, which ultimately have resulted into an indefinite postponement of the project. This has been actually the case of the proposal put up for connecting Baroda by meter gauge line to Dholaka. This has also resulted into indefinite postponement of the proposals to convert narrow gauge lines into meter or broad gauge, whichever is more convenient and suitable. A quick as well as firm decision and immediate action are the main things required in such matters, if the authorities really mean business and immediate as well as effectively useful action.

Ports of Gujarat handle about 40% of the total cargo of our country. Some of these, if properly developed can be a very great asset to our trade and business. None of our ports except Kandla is in a capacity to handle cargo in large quantities and in a quick manner. The work of development of minor and medium ports requires to be accelerated. It is gratifying to note that works of a dry dock for the port of Okha and improvement to a dry dock at Bhavanagar are to be done during the current year. Development of Porbunder, so as to make it fit for use in all seasons is also likely to be taken hand in near future.

As in roads, our state also lags behind other states in irrigation. Out of the three multi-purpose irrigation projects of the state, Narmada Scheme is still in the primary stage. The chief dam work has not been started at all. Sanction of the Planning Commission is still awaited for the Kadana Project, on river Mahi. Supply of water for irrigation in some areas have started through canals as part of the first stage of Mahi Right Bank Canal Project as well as Kakaraparh Scheme. We have been lucky to get a loan of 450 lakh of dollars from the International Development Association for the Shetrunji Scheme. The works under this scheme have progressed satisfactorily and a commencement has been made to start supply of water for irrigation in the nearby areas. Minor Irrigation works have acquired more importance in recent ears, as they are most suited to get quick results. Five hundred new tube wells are proposed in the Third Five Year Plan, against which estimates for only 100 wells are sanctioned so far. At the end of 1961-62, the state had a potentiality of irrigation in 11.42 lakhs of acres of land, while actual irrigation was done hardly in 4.68 lakh acres. Percentage of actual irrigation potentiality was very low, namely, 41.

We have not tackled some of our very important rivers at all so far for the purpose of irrigation. The most outstanding example is our largest river Narmada. The very large discharge of this river goes to waste at present. At times during heavy floods, it becomes a source of danger to the inhabitants on the banks. This is a visible manifestation of the waste of natural wealth. Similar is the case of rivers Sabarmati and Watrak. The water supply and irrigation potentialties of the river Watrak have not even drawn the attention of the authorities for the purpose of even investigation alone This shows that in our future plans, we will have to construct large projects worth several hundreds of crores of rupees. News, have however, been published in newspapers recently about the successful negotiations by our Chief Minister regarding the irrigation projects on Narmada. We hope the works will be taken in hand immediately, as our state will be able to get a very large quantity of electricity over and above water for irrigation. There is an excellent opportunity for reclaiming the Rann of Cutch. 10 lakhs of acres of very good land can be put straightway under cultivation. The only trouble is, that once having been under the sea, the land has large salt content. We have to wash this salt from the land and also to find out what kind of crops can be grown. This necessarily requires some experimentation. The Central Government should be pressed to undertake this work. Reclamation may take some time. But a precious opportunity should not be lost for the state to reclaimt he land from the sea and develop the same economically. It is essential that we should immediately take up such schemes as these can give us more food.

Shortage of electricity is the greatest handicap in the development of this state which started with a deficit at the time of its formation. It is assumed that the Dhuvaran Thermal power station will start functioning in 1964. News have also been received that the capacity of this Power Station is to be doubled in immediate future. This will surely be a great help in the development of at least a few industries in our state.

The most important aspect of this subject is the development of cheap and economical hydel power. We have such potentialities in Ukai and Narmada Projects. The work of the dam at Ukai has been already taken in hand. This requires to be expedited, so as to get the power therefrom as quickly as possible. The chief probable source of hydel power is the Narmada Project. This is still in the very early stages. We do not know whether it will be possible for us to get any power out of this project even by the end of the Fourth Plan. The Gujarat Electricity Board expected to get additional electrical power of 15,000 kW and laying of 15,000 km. of transmission lines by March 1963. It also hoped to provide energy of 440 small towns and villages so as to serve 65,000 new consumers during the same period.

We get tidal waves at Bhavnagar and other places in the state. The difference between ebb and the flow tide is about 35 ft. We can very well generate power from these tides. France is producing power from such a source. Continuous technological advance is necessary to find out and produce more and more power in our state.

Several water supply schemes have been taken up in the state during the First and the Second Plans. These are continued in the Third Plan period also. Most of the towns as well as many large and medium size villages have provided complete or partial water supply schemes and have been able to provide to the people the most essential necessity of life. In comparison to the same, arrangements for the disposal of waste and sullage water are very poor. The problem is becoming acute in towns as well as in villages, resulting in very dirty streets and nuisance of mosquitoes throughout the whole year. Systematic sewerage is the only solution to this. Disposal of the sewage will not be a very difficult problem in consideration of the fact that large agricultural areas are almost available in proximity of every such place. Treatment in oxidation ponds has been found a very cheap and convenient method for the sewage from small populations and the effluent therefrom can be conveniently used either directly or by mixing with good water for agricultural purposes.

In present days, the progress of a country depends on the efficiency and talent of its engineers and scientists, who have to work as a team. We are still behind time in science and technology. We have yet to achieve a technical revolution. The situation calls for a reorientation of outlook and method of working. We have to be more dynamic than what we are at present.

Practical training of fresh engineering graduates deserves considerable importance. Apprenticeship schemes have not received in this country, the attention which they deserve. On training in a systematic and scientific manner will depend the standard of efficiency that will be necessary in the execution of our future plans. The basic training and subsequent experience which are normal for the professional engineer should be pre-eminently suited to the development of good managerial qualities.

It is felt that we require a large number of engineers to achieve our objectives in the Third and subsequent Five Year Plans. There has been a sudden expansion in our system of technical education. It is however noticed that there is general slackness in the quality, more emphasis being paid to quantity. Sacrifice of quality in favour of quantity will lead to dangerous consequences. This aspect has not been given due consideration in our state.

The well being of our people depends largely on planned development in the existing economic set-up. Our rate of progress must be accelerated, and our output of work per capita must be increased, if we have to catch up with the progress and developments that we find in other countries. Our people must be made technology minded.

Scientific knowledge is developing so fast that the concepts of today may be found out-of-date tomorrow. In this fast changing and highly competitive world, the need of continuing one's study is greater than ever before. The universities of the state should introduce specialist and refresher short term courses for engineers in various branches. Such courses will be definitly of great benefit to the engineers in service as well as in private practice.

Research in science and technology has great emphasis in the present times. Adequate facilities for research should be provided in Universities and industrial undertakings, so that specialization is possible in planning, design and construction in the country and we may not be required to depend on foreign consulting engineers.

Engineers are closely concerned with the development of water resources, transport facilities including railways, roads, civil aviation as well as ports and harbours, building activities, generation and distribution of electric power, telecommunications and so on. With the exception of the railways, all these departments, both at the centre and the state level, are generally not in the hands of engineers at the administrative level. The subordination of the technician to the mere administrator in the higher range of service is an anomaly. The engineers have an unenviable position in the present set-up, because they are made responsible for the achievement of targets, without being given the necessary authority. On the other hand, the entire authority almost vests in the representatives of finance and administration, whose responsibility lies mainly in the observance of set of rules and office procedures. The technical men are thus progressively debarred from taking their share of responsibility at government level and that non-technical administratives have been introduced between the ministers and heads of engineering departments. It is desirable that the engineers should organize and voice their opinion in the administration of the country in a more concerted manner than hitherto. In a democratic set-up, engineers need not necessarily be silent executors of works. They must take an effective part in guiding the policies of the Government. We must make all efforts to send eminent engineers to the various legislatures to represent engineering fraternity and try to secure seat in each state ministry. We are grateful to the Prime Minister of India for the appointment of two Past-President sof the Institution—Dr. A. N. Khosla as the Governor of Orissa, and Dr. K. L. Rao as Minister at the Centre. Let us hope that this is only a beginning and many more engineers will find their place in the parliament, state Assemblies and other policy making bodies in course of time, in order that they can contribute the engineering point of view on different problems arising out of the community effort to make life happier. The engineers' participation with his habit of accurate thinking and precision analysis will be highly beneficial.

We shall be failing in our duty towards ourselves as well as our profession, unless we all aim to develop engineering into a leading profession, second to none in its ideals and purposes. This could be best achieved through this Institution. An engineer should have moral and intellectual integrity, wide interest, genuine concern for the difficulties of his fellow professionals and courage to sacrifice self for service. Our work is evaluated by the contribution we are able to make to the progress of the nation. Let us, therefore, strive our best to emerge successful in this evaluation

Jai Hind.'

Madhya Pradesh Centre

Chairman's address by Prof. V. V. Sarwate, M.Sc., D.I.I.Sc., M.S.(Engg.), M.I.E., at the 5th Annual General Meeting of the Centre on January 13, 1964.

The Chairman welcomed the Chief Guest, Shri Parmanand Bhai Patel, Minister for P.W.D., Madhya Pradesh, and other invitees, and thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering his address, Prof. Sarwate said, 'Under the impact of successive Five Year Plans, India is slowly but surely developing its industries. This has provided our youth not only with vast avenues of employment at all levels but also an opportunity to display their creative abilities and inventive genius in the fields of science and technology. No wonder then that every fond parent desires his children to go in for a science and technology oriented course, and it is from this stage that our problems arise which so far have defied a satisfactory solution.

Teaching, learning and examining are the three important aspects of education. Like the legs of a three-legged stool, each is as important as the other. More than that, the three aspects must be inseparably welded together in any good educational system. However, in India, the common man has come to think of teaching and examining as entirely independent aspects of education, while the student regards learning as a necessary evil drudgery which one must undergo to get over the hurdle of examination. This illusion is probably fostered by the fact that here, unlike other countries today and even unlike our own country in the past, the teacher is not necessarily the examiner. In fact, the teaching institution is usually different from the examining organization. Many educationists believe that most of our educational problems can be tracked down to this situation.

First and foremost is the problem of numbers. Technological institutions are faced every year with vast numbers seeking admission. Every one of these applicants has the glittering vision of a well-paid job before him. He feels that if odly he can get admission in a technological institution, it would be like setting a sure foot on the ladder of success in life. It is of interest to note in passing that this trend is just the reverse of the trend in western countries. Thus, for example, in 1957, prior to the time when the first Sputnik went up before an astonished world, of all entrants to American Universities, about 12% registered for engineering courses. In 1963, this percentage had dropped to only 6% while the registration in sciences, particularly in mathematics, physics and chemistry, had gone up. The American educationists ascribe this to the well recognized fact that today, a person with brains has wider fields open to him for exercising his intellect in the pure and applied sciences than in technology.

In India, we find ourselves unable to provide a science or technology course to all those who want it. Selection of a small number then becomes necessary, with a consequent rejection of much larger number. Those who are selected are expected to realize that by this selection, the nation has entrusted a big task to them and that the nation expects them to apply themselves to their studies very devotedly.

But in practice a distressingly large number of students and their parents think just otherwise. They often tear official statements out of their context and claim that since the nation cannot afford the tremendous wastage caused by failures, therefore the academic regulations and standards should be altered to enable a larger number to be declared as passed. Either, no one exhorts our students to study more devotedly because the nation's very existence is at stake, or this matter is not considered to be of sufficient news value to be reported. As a result the impression is generally created that the students are doing their best and cannot, and should not, be expected to do better even in a national emergency.

In the field of technological education, the Institution is filling a very important need in tackling this problem of numbers. Every individual has the right to acquire more knowledge and thus improve his prospects of employment in a better paid job. This right everyone has, but not necessarily the opportunity. Under the stress of economic difficulties, many students have to give up their education early and to seek employment in the industries that are rapidly coming up. For such employees in the engineering field, the Institution provides an opportunity to 'Earn and Learn'. Though this has not been possible for the Madhya Pradesh Centre to do because of lack of suitable accommodation, at other Centres of the Institution which have a building of their own, evening classes are conducted for the benefit of these workers to learn and to appear in the Institution's examinations. With the introduction of the New Scheme of subjects from the November 1962 examination, this system is now geared up to meet the needs of the modernized industry. Moreover, the Institution of Engineers is one of the few examining bodies in India which has not lowered its standards in spite of the fact that the percentage of passes is hardly 15%.

The history of the development of scienific thought and technology shows that the majority of the important contributions are made by persons in the age group 25-35 with progressively rapid decrease as we go to higher age groups like 35-45, and 45-55. But a person does not suddenly develop the creative faculty when he reaches the age of 25 years ; he has to be carefully nurtured over a number of years from his high school onward. However, much one may like that a one-hundred-percent reliable aptitude test be developed to indicate which of the high school students can later develop into creative scientists and engineers, the plain fact remains that such tests are just not there.

Other countries in the world have tried to get around this problem by assuming that everyone is capable of rising up to the highest level, and basing their courses accordingly. If some students fail to come up to the desired standards, it is not the standards that are altered, but it is these students who are diverted to less exacting courses intended to train personnel for other types of jobs. Thus the nation is assured of the requisite personnel at all levels from the highest downwards, and also each individual has been given an opportunity to rise up to the highest level that he is capable of doing.

But whenever similar methods have been attempted here, we have complained against the educational authorities for prescribing unnecessarily stiff courses for our children when we only want them to get a degree and land a well-paid job. Under persistent popular pressure for greater percentage of passes, our courses have been watered down in schools, then at undergraduate level and finally even at post-graduate level in the fond hope that those who aspire to become experts will somehow look for themselves. If they cannot, well it does not really matter because we can always get foreign experts whenever we need. The other day the newspapers reported that we were to get a foreign expert to tell us how to increase our population of frogs, since it is found that frogs can be exchanged for much needed dollars.

This being our general attitude towards learning. I was astonished to read another news item that students of a university had gone on strike demanding that they should have more extensive courses and also stiffer examinations ; as usual, of course, they called off the strike only when the authorities accepted their demands. At first I thought that I was dreaming until on reading the news again, I discovered that this referred to students of University of Milan in Italy. For our student leaders here, a strike for such a cause is absolutely unthinkable. Not even after the impact of Chinese aggression has any body of students felt inspired to put forward such a demand.

One of the effects of this toning down of our standards has been that the better students fail to find the intellectual challenge that is so vital for progress. There is no dearth of intellect in our students of today as is evident from the excellent record of these students when they have gone abroad and competed with students in foreign universities. The fact that many of these Indian students abroad dislike returning to Indian institutions underlines the fact that our educational institutions are not able to provide the desired food for intellect. Hunger of the brain is just as powerful a force to reckon with as the hunger of the stomach. Today it has merely driven our better brains to seek asylum in foreign institutions. But if this process is allowed to continue, we may have to pay a very heavy price in a couple of decades because of this stifling of our nation's brain power.

This does not mean that at present, we have no good institutions in the country but that they are very few. It is not merely the institutions devoted purely to research work that one has to think of, but also colleges and high schools because the tender care of the nation's brain power has to start quite early in the life of the individual, and certainly not later than an age of about 15 years. But if a child shows signs of possessing intellect better than average, the chances are that it may not be possible to find any school or college in the neighbourhood for imparting the type of instruction and attention that he would have got in another country. This is a great loss : we cannot afford to neglect or squander away this brain power or allow this flower to blush unseen and waste its sweetness on the desert air.

A person from the planet Mars coming to India and studying our educational system is likely to arrive at the conclusion that it is 'failure-oriented'. We seem to be obsessed with the fate of those who fail to come up to the required standards. The greater portion of the ordinances relating to various examinations is devoted to the cases of different types of failures. With the increase in the number of students taking examinations, there has been a corresponding increase in the number—not the percentage—of those who fail. These are the favoured few who agitate and about whom we are all agitated, parents and politicians, eminent educationists and ordinary orators alike. Hair splitting arguments are then carried out to differentiate between various shades or degrees of failing and ordinances amended from time to time till they are deformed out of shape and no one knows any longer what precisely is the standard desired.

All this preoccupation with failures arises from the fact that as a nation we are committed to the policy of providing equal opportunity for all, and we set about achieving it in the wrong way. Since failure in examinations closes the doors to employment opportunities, we modify our educational system to suit the convenience of the failures. As a result all that we seem to have achieved so far is not a provision of equal opportunity to all to learn but a denial of opportunity equally to all to acquire any worthwhile knowledge.

Perhaps the most tragic weakness of our educational system lies in the process of learning. No one wants to learn anything if he feels that it is not likely to occur in the next examination. 'Knowledge is Power' copies the student in his note-book, but he never feels that this has any reference to him. If forced to think about it, he will claim that lack of knowledge has not prevented hundreds of people known to him from securing well-paid jobs. In the case of individuals, it may be possible to evade the consequences of lack of knowledge with suitable 'pull' and 'push', but a nation that lacks knowledge is at the mercy of others in this ruthlessly competitive world.

Realizing this, the authorities have evolved various schemes to bring knowledge within the reach of all. Low-cost text-books have been published. The Institution has established Book Banks in colleges. Scholarships in various forms are awarded.

But it seems that all these attempts to bring the books and students together are not enough, and the book-sellers have a different tale to tell. The sale of help books, solved guess papers and like literature has rocketed to unprecedented heights. It looks as if we have made the gambler's hope of getting 'something for nothing' as our national characteristic.

In connection with education we often hear nowadays about student indiscipline. Reading frequent comments on the subject in newspapers, we are likely to conclude that for some reason, this generation of students belongs to another species which is inherently bad and is incorrigible. I am afraid I am unable to agree with this view. I do not find the student of today essentially any different from the student of say 30 years ago. His behaviour sometimes may not be what is desired, but the fault certainly does not lie with him. If his mind is not fully taken up with his studies it is bound to become the devil's workshop. If at all anyone is to be blamed for this, we must face the fact that it is we the parents who are indisciplined. Let me explain this.

In ancient times our forefathers used to send their children to the well known institutions to acquire knowledge at the feet of the *Guru*. The *Guru* and his pupils then worked out the entire process of education—teaching, learning and examining—between themselves without the least interference from the parents or the society. Until recently we had preserved this sanctity of education to some extent. But in the last decade or so we have interfered in the educational process to such an extent that the terminology of the market place is now heard in our educational institutions. We hear of all being fair in this love for immediate profit for self or war with teachers and examiners. Dishonesty and cheating in day to day work or examinations is not bad so long as you do not get caught. In this sale of knowledge, the student has been reduced to the status of a pawn. And as for the teacher, our Vice-President Dr. Zakir Hussain himself expressed surprise that teachers who had to carry out educational policies had no hand in framing them and were not even consulted by the policy makers.

To sum up then the problem before us is that if we wish to survive as a nation, we have to evolve an educational pattern to impart knowledge effectively to our children. A speedy solution is urgently needed because the sands are fast running out, and revolutions are said to occur if the evolution is too slow. But the proper climate for this change can only be created by us if we restore education to its sacred place on a pedestal from which we have pulled it down, and we begin to look upon our educational institutions as temples of learning rather than as fish market. The western nations and also Japan have done precisely this and shown that this is the only way to a naton's progress. Even the communist countries, which are said to be far from religious in our sense, have done this and attained world class in a couple of decades. Then why not we ?'

Nagpur Centre

Chairman's address by Shri R. S. Mehta, B.E., M.C.E., F.Am. S.C.E., M.I.E. Annual General Meeting of the Centre on January 27, 1964.

The Chairman welcomed the Chief Guest, Air Vice Marshal Mehera of the Indian Air Force, and other invitees, and thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering his address, Shri Mehta said 'The national emergency is yet not over and one does not know how long this situation is going to continue. The Chinese aggression has created a situation which calls for an increased effort for every Indian citizen. During the previous years, the Institution has played its part by marshalling the technical knowledge and experience of its members for the benefit of the country. National defence has presented many new problems to the engineers and we have to utilise this opportunity to accelerate the progress in engineering, science and technology and in engineering research for the general benefit of the nation.

Our country has been forced to spend a large amount of money for the defence needs. It is, therefore, the duty of the engineers to economize on the cost of constructions by more meticulous engineering design and construction. Research on the use of alternative materials of construction and designs will result in the saving of essential materials like cement and steel and bring in an alround economy in construction. Other countries have done the same thing during the war years. The progress in technology and science during the period of national crises has always been very many times more than during the peacetime, and most of the inventions were made during those trying years.

We are aware that the war conditions exist on our northern frontiers. Many of us have still no clear idea as to what are the difficult problems that the army is facing at those high altitudes. High altitude warfare is comparatively new to us and we have yet to find solutions to many of their problems. Army engineers and scientists alone cannot possibly cope up with all those problems as many of them need long term study and research. I shall only enumerate a few problems of sanitary engineering. In these high altitudes of 12,000 ft. and above, the temperature goes down to several degrees below zero and remains like that for a few months. This low temperature at high altitudes creates problems which are never faced on the plains. The mountainous terrain and the necessity of airlifting some of the materials and requirements create still further problems. Miles of roads have to be constructed for mechanised transport. Airports have to be constructed at high altitudes. Permanent camps are to be constructed at certain strategic places and temporary camps at yet other places. Where there is permanent concentration of population, we want sanitary facilities, running water supplies and sanitary disposal of waste waters. Certain treatment processes are not effective at those altitudes as bacterias do not thrive at these temperatures and the biological processes of purification stop functioning. Pure and uncontaminated water is needed for the fighting forces both in the camps and also in the field. Light materials are needed for laying pipes and conduits, as in many situations the materials have been airlifted and delivered to the site. Anti-freezing devices have to be used for transport and other vehicles as well as in water systems. Special water filters are needed for townships and for mobile camps. Special methods of disposal of human wastes have to be evolved. Pumping stations have to be heated. Every effort has to be made to see that the wastes do not contaminate the water in the camps and that the health of the fighters and workers is maintained at its best. For this type of original work, we need young men with courage and creative ideas. These problems need study and research and it is a challenge to the skill of engineering, technology, and science. In the emergency, therefore, we want more engineers to be produced every year and for that we have to gear up our existing engineering colleges and schools and start short term and refresher courses.

Let us now turn our attention to our another bigger enemy in the country poverty and disease. We have completed two Five Year Plans and are in the midst of the Third Five Year Plan. We have made great strides in setting up large industries. We have constructed large mulipurpose dams and have supplied irrigation water to millions of acres of land, We have generated lot of electric power by hydroelectic and thermal plants. Three large new steel plants have been commissioned. Several cement factories and new heavy chemical and electrical plants have been started. Several fertilizer plants, oil refineries, autmobile and aircraft factories, machine tools factories, atomic energy plants, etc., have been installed. Several new industrial township have come up, and there is all-round progress in industrialising our country.

In spite of all these, we have still not solved the problem of poverty. Millions of our people suffering from malnutrition and diseases. Many of these diseases are water-borne, such as, cholera, typhoid, dysentery, etc., and could be prevented and completely eliminated as has been done in developed countries. It has been said by one of the world's renowned medical authority that 'If a single programme were to be chosen which would have the maximum health benefit, which would rapidly stimulate social and economic development, and which would materially improve the standard of living of the people, that programme would be water supply'. There is a direct relation between safe water and good health and the improvementof health makes man more productive. I have shown on the board the economic cycle of disease (Fig. 1) and the economic cycle of well-being (Fig. 2). It shows the inter-relationship of the disease, low production and poor water supplies as also high production and good services, adequate water supplies and well being.

In spite of 16 years of freedom, we have not been able to provide the basic amenity such as pure water to a large portion of our population. Let us divide the problem into two parts: Urban and Rural. The urban population of India is about 73.83 million people and is distributed in over 2,690 towns. 248 cities have a population of more than 50,000 people. According to the figures available in the Ministry of Health, only 34% of the total urban population can be said to enjoy water supply and sanitation facilities at a satisfactory level. This includes towns like Calcutta, Bombay, Madras, etc. which have water supplies which are outmoded and very insufficient in quantity for the increased population. Only 20.6% of the urban population has sewerage system. We have spent only 72 crores during the plan periods. The work yet to be done to cover the urban areas with adequate water supply and satisfactory sanitation facilities is of a very big magnitude and would involve an expenditure of about one thousand crores of rupees.

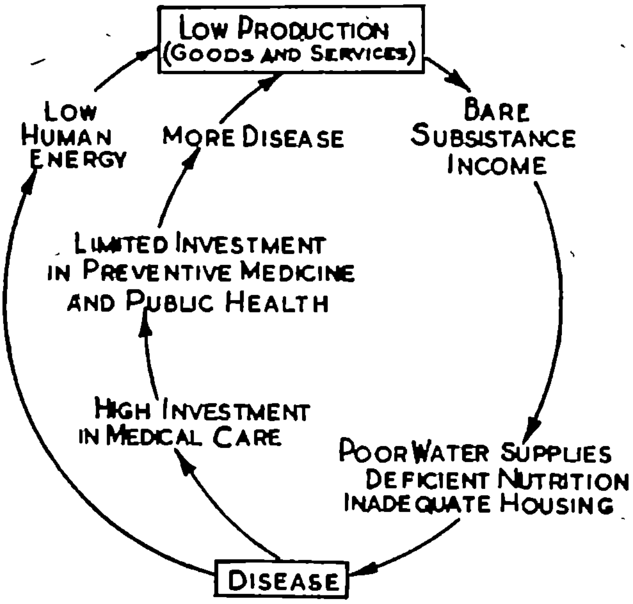


Fig. 1

The economic cycle of disease

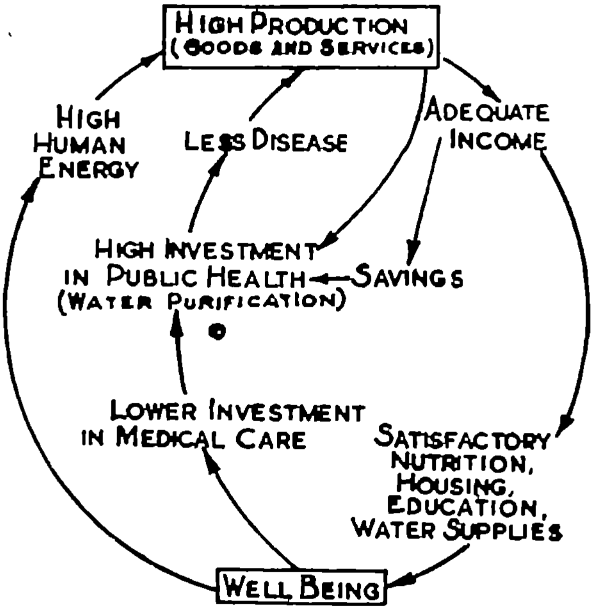


Fig. 2

The economic cycle of well-being

On the rural side, the picture is still more dismal. We have 5,64,000 villages with a total population of 359 millions. Out of this, about 4,68,000 villages have a population of less than 1000. The responsibility of rural water supplies has been assigned to more than one agency. Some rural wells are provided by the Community Development Programmes, some through the Backward Classes Welfare Programmes, some through the Supply and Sanitation Programmes and the remaining through the Local Development Works Programmes. The total money that would be spent in three plans would be Rs. 37 crores. Large number of rural wells have been provided under these programmes. But the authorities implemening the programme do not know what a good sanitary well is, with the result that, I feel a lot of our effort and money is being wasted. It is necessary, therefore, to carefully assess as to what extent this work yields safe water supplies to the communities served.

There are areas where the waters are brackish; there are areas where the waters contain an excess of fluorides; there are areas where waters are highly contaminated. In these areas, it is not possible to provide ordinary wells, as even though it may yield water, the quality of the same would be much below the standard, and in some cases even dangerous. Some of these villages have to be grouped together and supplied water from some distant source, may it be a perennial river or a large reservoir or a perennial canal. In some other cases, such waters have to be properly treated. We have practically not yet tackled these community supplies at all.

For all these schemes, we will need large amount of funds, approximately about 8000 crores of rupees, which will pay direct dividends, if the schemes are properly worked out and executed. The indirect benefits would be a healthy generation free from diseases, who would be able to produce more and lead a fuller life. This would largely cut down the idle hours lost due to sickness and the cost of medicines.

I am giving below some suggestions for setting up of a machinery which could tackle the problem of water supplies, if the same is to be completed in about 15 to 20 years :

1. Water supply has suffered at the hands of the local self-governing bodies. It should be handed over to the statutory water and sewage boards.
2. There should be separate departments of public health engineering in every state. Some states have taken a lead and have established such departments. Even in a progressive state like Maharashtra, there is no separate public health engineering department.
3. States should give special training to public health engineers in established post-graduate colleges at 5 places in the country. For such specialised training, special remuneration should be given to engineers.
4. Facilities should be provided for training of subordinate engineering staff in public health engineering.
5. Special short term courses should be organised for training of water and sewage treatment plant operators.

6. Evaluation of the materials and equipment needs for implementing the projects should be done, and if necessary, starting of new factories for the production of cast iron and plastic pipes, etc. and, standardization of treatment plants should be taken up.
7. Water supply and waste disposal should receive the high priority it deserves in the state budgets.
8. The solution of urban and rural problems calls for fundamental and applied research, and every supports should be given to educational and research institutions who are actively engaged in research.'

Summaries of Papers Published in the Journal, vol. 44, no. 8, pt. EL 4, April 1964

ELECTRICAL ENGINEERING DIVISION

Some Experience in the Construction and Commissioning of Bradwell Nuclear Power Station in Great Britain

S. K. Biswas

Associate Member

The total installed capacity of electricity generating stations in Great Britain in 1960 was about 30,000 MW and these stations generated, mainly by burning coal, 1,13,000 million kWh of electricity. The Ministry of Power decided to place orders for nuclear power stations at the rate of roughly one every year. As the capacity of the individual station is likely to increase, this means a steadily raising rate of nuclear commissioning which should give the country about 5,000 MW capacity in 1968. There are about eight nuclear power stations of gas cooled graphite moderated type being built in England, for the generation of electricity. Besides Calder Hall, Bradwell nuclear power station was the first civil station which was built in Great Britain to supply electricity to the national grid. Bradwell station was designed and constructed for the Central Electricity Generating Board by the Nuclear Power Group. Both the reactors of Bradwell nuclear power station started feeding the national grid towards the end of last year. The data obtained at Bradwell are still undergoing treatment.

Theory and Use of the Analogue Computer in Solving Vibration Problems

D. P. Garg

Non-member

Electronic analogue computers are relatively simple devices used to perform mathematical computation automatically. In this paper an attempt is made to introduce the use of analogue computers in a simple way. The analogue and digital computers are compared and their specific advantages and applications of the former listed. The theoretical basis for various mathematical operations is discussed and a few illustrative problems are worked out. A few types of function generators and function multipliers are described and their use in solving nonlinear differential equations illustrated.

Analyses and Design for Satisfactory Governing of Hydro-Electric Stations

K. Madhavan
Associate Member
and
A. N. Singh
Non-member

In this paper, an attempt is made to focus attention on the fundamental relationship between the factors which influence control of frequency of generating plants and to evolve procedure for quantitative calculation of the performance of hydro units in this respect. The calculations form an important part of the hydraulic studies necessary for the choice of elements of hydraulic system, *viz.*, surge tanks, penstocks, pressure regulator, governor setting, inertia of machine, and may even influence the choice of the type of turbine. Such studies will ensure that the hydro-station will provide the response which is expected of it. Alternatively, in certain severe conditions, *e.g.*, plants with long penstocks, Kaplan turbines under low heads, it is possible to assess the restrictions that must be placed on the operation of plant consistent with economy.

Developments in Steel Mill Drives and Control

S. K. Pande
Associate Member

As in other fields of electrical engineering activity, much advancement and refinement has been witnesses of late in the electrical equipments now being employed in steel mills. This paper briefly touches on the recent developments in the entire sphere of electrical applications as related to steel mills comprising drive systems, machines, control circuitry, regulators, and other items like cranes, static converters, etc.

The 90° Compensation in the Induction Type Single-Phase Energy Meter

P. V. N. Ramanathan
Associate Member

The electricity meter form an important link between the supply undertaking and the consumer. It has to register correctly both under non-inductive as well as inductive loading. The necessity for compensating system to 90° is explained. It is also explained how compensation is adjusted during calibration. The error in registration that would accrue if the meter is incorrectly compensated is mathematically derived.

Analytical Treatment of Simultaneous Faults in a Power System Using α, β and 0 Components

Prof. H. N. Ramachandra Rao

Member

and

K. Parthasarathy

Non-member

In analyzing the performance of protective devices during simultaneous faults in a power system, it is necessary to calculate the system, currents and voltages through the network. In this paper, the fault analysis is done analytically by using α, β and 0 components. The positive and negative sequence impedances of rotating polyphase machines can be assumed to be equal without serious error, thus making the use of α, β and 0 components practicable. The application of these components will prove to be very useful in obtaining simpler solutions for all cases of simultaneous faults; and hence, in studying the probable operation of protective relays. Only two cases of simultaneous faults are discussed in this paper and the other cases may be worked out on the same lines.

HINDI SECTION

National Buildings Organization : Its Work and Responsibilities

G. C. Mathur

Non-member

The paper briefly describes the functions and the set-up of the National Buildings Organization (N.B.O.) which is also Regional Housing Centre of the U.N. Economic Commission for Asia and the Far East. The role of the N.B.O. in coordinating building research and providing technical service to the building industry has been emphasized. The type of publications brought out by the Organization for people of different levels has been indicated. It gives a brief account of the important work done by the N.B.O., with special reference to : improvements in the traditional building materials ; utilization of industrial waste for the production of building materials ; evolution of space norms and standards for repetitive types of buildings ; climatic suitability of designs ; experimental building work ; rural housing activities ; and socio-economic aspects of housing. While discussing these, the problems and difficulties which the Organization has to face have also been referred to.

Materials of Construction for Gas Turbines

C. B. Misra

Graduate

Though the gas turbine was invented a long time ago, the science of metallurgy had not developed sufficiently. Therefore, there were many difficulties in the construction of such machines ; unavailability of suitable metals was the main obstacle. Numerous new alloys have now been developed to overcome these obstacles and the gas turbines now being utilized in prime mover such as locomotives, motor cars, aeroplanes, steamers, etc., besides power generation. This short paper describes the development of gas turbine.

The Demand Patterns of India of Tomorrow

Dr. K. L. Rao

Honorary Life Member

This is a Hindi translation of the Seventh Sir M. Visvesvaraya Lecture delivered by Dr. K. L. Rao on February 9, 1964, on the occassion of the 44th Annual Convention of the Institution at Hyderabad.

Dr. Rao has estimated the requirements of India in the year 2000 A.D. in respect of the agricultural and industrial production on the basis of the present trend of development and targets set out for the Third Five Year Plan. He has also taken into account the anticipated increase in the population by that time. In estimating the requirements he has taken into consideration the economic conditions prevailing some 40 years ago in such of the countries as were close to our present conditions. Land utilization pattern in India for the present and the future, present yields and future requirements of agricultural products in India, sectoral break up of national income for various countries in 1960 and estimate for India for 2000 A.D., and estimates of industrial production in India in 2000 A.D., have been shown in various tables.

Three aspects, *viz.*, water, power, and steel have been dealt with and the author has concluded that the resources of the country will be able to meet with all the requirements provided we start in earnest right now to harness all the energy and the material available to us. The picture of an intermediate stage, *viz.*, 1980 A.D. is hopeful. and the picture of the needs of the country in 2000 A.D., though alarming, indicates that we should make a bold and radical approach to our problems. A five times increase in the rate of per capita income is the minimum requirement, and if the increase in population is taken into account the total increase in the national income would be ten fold. For this a huge reservoir of technical skill will also be necessary. Thus what India needs immediately today is relentless restriction on population growth and a reservoir of technical manpower. Only then can the political independence be ratified by economic liberation.

Interesting Innovations at Aswan High Dam

Dr. K. L. Rao

Honorary Life Member

The new High Aswan Dam has been planned by Egypt on the river Nile 7 km. upstream of the old Aswan Dam to meet the greatly increased need of water for irrigation and power. Its storage of 157,000 million c.m. will dwarf the pooled storage of the total of all the major projects in India. As regards its capacity for power generation, it will have twelve units of 175.00 kW totalling to 2.1 million kW. The builders of Aswan High Dam are boldly pressing into service the latest techniques from all over the world and developing quite a few of their own. The new rockfill dam will stand 111 m. above the bed made up of rockfill. Instead of providing a spillway over a portion of the dam to allow excess flood water to flow smoothly, the surplus water will be let down through passages between the power units of the hydro station at the foot of the dam. To ensure its speedy completion at the least possible cost, the Government of Egypt have assigned an exclusive chief and a whole time minister who is also an engineer for this Dam. In 1968, when the High Aswan Dam touches its peak, it will be a matter of pride not only for the Egyptian engineers, but also for the east.

Work-Study in Railway Workshops

S. C. Vadera
Non-member

Systems of work-study in railway workshops were introduced in the third decade of the twentieth century, when some British Production Engineers were appointed in important railway workshops. But these gradually faded away after their departure, and only a few remnants were left after the Second World War in Moghalpura workshops in Pakistan. These were again produced after the establishment of Chittaranjan Locomotives in West Bengal, and later on in other workshops. As a result of these work-studies, it has been possible to reduce the number of workmen by 8,000, who have been usefully employed on other jobs. This has resulted in great saving of time and cost not only on manufacture of new locomotives and their parts, but also on repairs of locomotives and other railway rolling stock.

Valuation of Immovable Property—2

Vishwambhar Prasad
Associate Member

This second part of the paper deals with some aspects which were either not dealt with in the first part or were only briefly mentioned for want of space there. These have been considered necessary in view of the discussions on the original paper held at the 44th Annual Convention of the Institution as also because of the demand from various readers received now and then.

The article deals with three aspects, *viz.*, the method of calculation of depreciation according to the Income Tax Act, valuation of land, and the form and use of years purchase tables. The calculation of depreciation according to the Income Tax Act has been given only briefly while the methods of valuation of land have been dealt with in detail. The formulae in use have also been mentioned along with a note of warning that the valuation which depends upon the utility of land cannot be given a coating of arithmetical formulae none of which are universally acceptable. The valuation being not a science, stress has been laid on the judgment and experience of the valuer and the various aspects which need be taken into consideration in arriving at reasonable results.

The forms of various annuity tables and years purchase tables have been given. Keeping in view the lengthy nature and complicated methods of use of these tables, the author has tried to consolidate a number of tables in small graphs from which values correct up to two places of decimal can be read out directly.

INSTITUTION NOTICES

Suggestions for re-formation of General Engineering Division

Suggestions have been received in this office in regard to the re-formation of the General Engineering Division which was abolished according to the Bye-Laws of the Institution as passed by the Corporate Members in General Meeting at Calcutta on October 19, 1963.

Attachment to this Division, if formed, will be open to Corporate Members and Graduates of the Institution. (Students are not classified under the Divisions of Engineering specified under Bye-Law 7).

Prior to the adoption of the latest Bye-Laws of 19th October, 1963, the classification of each Corporate Member and Graduate as given in the Year-Book or their letter of election or attchment was based on the information made available by the member himself in his original application form and the Membership Allotment Form attached to March 1961 Bulletin and was according to his own choice.

In terms of the Bye-Law 10 which reads :

> 'Corporate Members and Graduate shall be attached to one Division only based on their educational qualifications approved by the Council at the time of their admission to the Institution, but if so qualified for attachment to more than one Division, a Corporate Member and a Graduate shall be allowed to select and change to the Division to which he would like to be attached. The Council may, however, at their discretion, allow the transfer of a Corporate Member or Graduate from one Division to another provided he establishes to their satisfaction that he deserves such transfer on account of change in the field of his practice of engineering subsequent to his election as a Corporate Member or Graduate.
>
> Corporate Members and Graduates may take part in the technical activities of one or more Divisions other than their own in accordance with rules, made from time to time by the Council.'

It is now however necessary that Corporate Members and Graduates are re-classified so that they are attached to only one Division, and only one Division will be shown against each name in the Year-Book.

This will mean that those who desire to be attached to a Division other than the one to which they are presently attached will be removed from the Division to which they are attached now and will be attached to the Division desired by them, provided they are so qualified under Bye-Law 10 (where a Corporate Member or Graduate desires to be attached to a Division other than the Division to which he would be attached by virtue of his educational qualification at the time of his admission to the Institution, his request will be placed before the Council in terms of Bye-Law 10 for consideration).

In consequence, in order to assess the strength of members who support the reformation of the General Engineering Division and like to be attached to this Division if formed, a census is now being taken through the requisition card attached to this *Bulletin*, meant for attachment to the General Engineering Division (if formed).

As this is the only satisfactory means of ascertaining the representative strength of members desirous of being attached to the suggested General Engineering Division, you are requested to return the card, complete in all respects, not later than June 29, 1964.

Draft Indian Standard

The following draft amendment has been issued recently.

Draft Amendment No. 1 to IS: 811-1961 Cold Formed Light Gauge Structural Steel Sections.

Members may send their comments on the above draft amendment before June 30, 1964, to Shri G. C. Khanna (*M.*), Chief Engineer, Punjab P.W.D., B & R Branch, Patiala, who is the Institution representative on the Sectional Committee dealing with tis Standard, and a copy to Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, The Institution of Engineers (India), Department of Civil & Hydraulic Engineering, Indian Institute of Science, Bangalore 12.

Copies of the draft amendment may be obtained from the office of the Indian Standard Institution, 9 Bahadur Shah Zafar Marg, New Delhi 1; or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay, 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 2/12 First Line Beach, Madras 1; or 14/69 Civil Lines, Kanpur.

INSTITUTION NEWS

Documentation Service of the Federation Internationale de la Precontrainte

The Administrative Council of the Federaic Internationale de la Precontrainte (FIP) has decided to start a documentation service covering the world's literature on prestressed concrete whereby abstracts will be provided giving full bibliographical reference to the original article, using UDC and SFB classifications and also key words. It is proposed that the abstracts be compiled monthly starting with January 1964. The cost of the publication is £5.50d per annum. This subscription will include a dictionary of key words which is now under preparation.

Members wishing to become subscribers to the service may contact the General Secretary, Federation Internationale de la Precontrainte, Terminal House, Grosvenor Gardens, London, S.W. 1.

FORTHCOMING CONFERENCE

34th Annual Research Session of the Central Board of Irrigation and Power, Simla, July 2-7, 1964

The 34th Annual Research Session of the Central Board of Irrigation and Power will be held at Simla from July 2 to 7, 1964.

papers on the following subjects will be discussed at the Session :

(i) Hydrology and Irrigation Design of River Valley Structures ;
(ii) Navigation Construction Materials and Practices ;
(iii) Hydraulics—Instrumentation, etc. ;
(iv) Hydraulics—Theory ;
(v) Hydraulics—Hydraulics—Model Studies for Projects ; and
(vi) Soil Mechanics and Foundation Engineering.

Members wishing to attend this session may contact the Secretary, Central Board of Irrigation and Power, Curzon Road, New Delhi 1, for further details of the session and accommodation.

Symposium on 'Evaluation of Rural Latrine Design,' Nagpur, October 1964

The Central Public Health Engineering Research Institute, Nagpur, is arranging to hold a symposium on 'Evaluation of Rural Latrine Design' in Nagpur during the third week of October 1964. Original articles or proposals should be sent to the Central Public Health Engineering Research Institute, before July 15, 1964, for discussion at the symposium.

Further details can be obtained from the Director, Central Public Health Engineering Research Institute, Nagpur 3.

Symposium on 'Behaviour of Soil under Stress', Indian Institute of Science, Bangalore, January 1965

The Fifth Symposium of the Civil and Hydraulic Enginering Department of the Indian Institute of Science, Bangalore, will be held in January, 1965. The subject chosen for the symposium is 'Behaviour of Soil under Stress'. Till recent times efforts have been concentrated mainly on the study of properties of saturated soils, while sufficient attempt has not been made to study the behaviour of partially saturated soils due to the highly complex nature of the problem. However, the present state of knowledge is being increasingly realized to be inadequate when applied to partially saturated soils such as compacted fills in earth structures as also most of the natural deposits in tropics.

The following topics are suggested for presentation of papers.

1. Behaviour of Soils with Special Reference to Tropical Conditions :
    - (i) Analytical and experimental studies on saturated soils ;
    - (ii) Studies on partially saturated soils ;
    - (iii) Behaviour of artificially strengthened soils ; and
    - (iv) Special problems pertaining to tropical soils.
2. Behaviour of Soils under Time-Dependent Loading :
    - (i) Behaviour of soils under vibratory load ; and
    - (ii) Soil problems in seismic zones.
3. Interaction between Foundation Structure and Soil.

Authors of papers should submit the title and summary of abot 300 words of their proposed papers by the end of June 1964 and three copies of the full text in publishable form by the middle of October 1964, to the Convenor of the Symposium, Civil and Hydraulic Engineering Department, Indian Institute of Science, Bangalore 12.

Further details can be obtained from the Convenor.

IFAC-IFIP Conference 1964, Stockholm, September 21-24, 1964

An international conference on 'Application of Digital Computers for Process Control' will be held in Stockholm, Sweden, from September 21 to 24, 1964, under the auspices of the International Federation of Automatic Control (IFAC), and the Internation Federation for Information Processing (IFIP). A joint IFAC-IFIP programme Committee has invited about 20 users of control systems to present papers in the various application fields given below. There will be oral discussion on these papers at the Conference.

1. Chemical and Petroleum Industry ;
2. Iron and Steel Industry ;
3. Public Utility : electric power and gas ; and
4. Other Applications : paper machine, cement kiln control, railway operation, and traffic control in mines.

Further details can be obtained from : IFAC-IFIP Conference 1964, Swedish Conference Office, Box 320, Stockholm 1, Sweden.

Conference on 'Lasers and Their Applications'
London, September 29-October 1, 1964

The Electronics and Science and General Divisions of the Institution of Electrical Engineers, London, will hold a Conference on 'Lasers and Their Applications' at Savoy Place from September 29 to October 1, 1964.

The aim of the Conference is to survey present knowledge of lasers, coherent-light and quasi-coherent light sources and the possible applications of lasers, as a guide to potential users and those concerned with device developments.

The Conference will cover:

Gas, solid-state (injection) and liquid type lasers ancillary devices, including optical superheterodyne receivers, detectors and modulators.

Propagation, in free space, and optical pipes.

Techniques for power, noise, spectrum and coherence measurements.

Optical radiation hazards, including physiological effects and necessary precautions.

Applications, including communications, ranging and navigation, micromachining and microwelding, and uses in medicine.

Further details and registration forms may be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Eighth International Course in Hydraulic Engineering, Delft, October 22, 1964-September 12, 1965

The Eighth International Course in Hydraulic Engineering will be held from October 22, 1964, to September 12, 1965, at Delft, The Netherland. The course is organized by the Technological University at Delft in collaboration with The Netherland Universities Foundations for International Cooperation (NUFFIC), and is intended for graduates in civil and hydraulic engineering with practical experience. The language of instruction is English. The programme allows a choice between:

1. Tidal and Coastal Engineering (including harbours);
2. Rivers and Navigation Works;
3. Reclamation (including ground water recovery);
4. Foundation Engineering;
5. Theoretical and Experimental Hydraulics; and
6. Water Resources Inventory.

The course comprises lectures, group discussions, working visits and a period of individual and practical work, adapted to the special needs of the participant with a view to future work in his own country. The tuition fee of the course is 2,000 Dutch guilders (£ 198 approximately).

Further particulars may be obtained from NUFFIC, 27 Molenstraat, The Hague, Netherland.

The Fifth European Course in Sanitary Engineering, Delft, October 1964-September 1965

The Fifth European Course in Sanitary Engineering, organized by the Technological University at Delft and the Netherland Universities Foundation for International

Cooperation (NUFFIC) with the assistance of the World Health Organization, will be held from October 1964 to September 1965. The aim of the course is to provide civil engineers with special training in sanitary engineering to enable them to take part in the struggle with water pollution in the densely populated and highly industrialized area such as western Europe.

The study will be based on a broad foundation of fundamental subjects like social backgrounds, hygiene, chemistry, microbiology and hydrology. These lectures will be followed by discussions of the scientific and practical aspects of modern ground water recovery and water supply, storage and purification of sewage water and the disposal and disinfection of solid water.

Although the course is primarily intended for European engineer, qualified candidates from non-European countries are also allowed. The tuition fee for the course is 2,000 Dutch guilders (£ 198, approximately).

Further particulars may be obtained from NUFFIC, 27 Molenstraat, The Hague, Netherland.

Third World Conference on Earthquake Engineering, Auckland and Wellington (New Zealand), January-February 1965

The International Associate for Earthquake Engineering will organize the Third World Conference on Earthquake Engineering in Auckland and Wellington (New Zealand) in January-February 1965.

Papers are invited on the following subjects for oral presentation at the Conference.

1. Soil and foundation conditions related to earthquake problems
2. Analysis of structural response, instruments
3. Seismicity and earthquake ground motion
4. Earthquake resistant design
5. Recent strong motion earthquakes and resulting damage.

The last date for receipt of papers in New Zealand is January 30, 1964.

An exhibition has also been planned, and any item connected with earthquake and earthquake engineering will be acceptable by the New Zealand National Committee. Exhibits may include photographs, films, drawings, models, instrument, equipment and publications.

Further details regarding submission of papers, participation in the Congress exhibition may be had from the Administrative Secretary, Third World Conference on Earthquake Engineering, P.O. Box 5180, Wellington, New Zealand.

The Journees Internationales de Siderurgie, Amsterdam, March 29-31, 1965 ; and Dusseldorf, April 1-3, 1965

Centre National de Recherches Métallurgiques (Belgium) and Verein Deutscher Eisenhuttenleute (Federal Republic of Germany) will organize, in cooperation with Associazione Italiana di Metallurgia (Italy), Institut de Recherches de la Sidérurgie

(France) and The Iron and Steel Institute, (London), the Journees Internationales de Sidérurgie on the general subject of 'Automation in the Iron and Steel Industry' in Amsterdam (The Netherlands) from March 29 to 31, 1965; and in 'Düsseldorf (Germany) from April 1 to 3, 1965. The programme of the Amsterdam meeting will deal with the automation of sinter plants, blast furnaces, basic oxygen steelplants (L.D., L.D.-A.C., Kaldo); and in Düsseldorf the meeting will deal with the automation of rolling mills and their auxiliaries. The official languages will be: English, French and German; a system of simultaneous translation will be provided.

The provisional programme and forms of registration will be sent out during the month of June 1964. Registration will be accepted for the whole meeting, or for either the first or the second section of the meeting separately.

All registrations and requests for information should be sent to one of the following addresses: Centre National de Recherches Metallurgiques (CNRM), Abbaye du Val-Benoit, Liege, Belgium; or Verein Deutscher Eisenhuttenleute (VDEh), 4 Düsseldorf, Postfach, Federal Republic of Germany.

Second Commonwealth Welding Conference, London, April 26-May 7, 1965

The Second Commonwealth Welding Conference will be held in London, from April 20 to May 7, 1965, under the auspices of the Institute of Welding and the British Welding Research Association. Papers on the following subjects will be presented and discussed at the Conference.

1. Process Development
2. Bani Research
3. Education and Training
4. Material
5. Design of Welded Structures and Assemblies
6. Standard
7. Productivity and Economics
8. Quality control and Inspection.

Immediately prior to the Conference, the School of Welding Technology will offer a course of stidy on welding technology from March 29 to April 24, 1965. The course is intended for man occupying responsible positions in industrial concerns and for teachers of engineering at universities and technological colleges. The course will offer an opportunity to aquire first hand information on recent experience in research in the U.K. and is expected to be of particular value to teachers of engineering and metallurgy in universities, technical colleges and training centres, as well as to engineers and metallurgists in industry and public work. The course fee, inclusive of board and lodging in a university hall of residence, will be £ 210.

Further details can be obtained from the Registrar, School of Welding Technology, The Institute of Welding, 54 Princes Gate, London, S.W. 7.

BOOK ACKNOWLEDGMENTS

1. **Soil Testing for Engineers.** R. C. Sharma and B. K. Kaul. *India Printers*, Jullundur City, 1962.

The book though written for degree students will be useful for post-graduate students also reading Soil Mechanics and Highway Engineering as well as for practising engineers and personnel employed in soil testing laboratories. Only the common laboratory and field tests have been included in the book. One chapter has been devoted to each of the tests presented.

2. **Introduction to Bridges.** N. Krishnamurthy. *Rao & Raghavan*, Mysore 4, Second Revised and Enlarged Edition, 1963, Rs. 8.75. 484 pages.

The book contains basic principles of all aspects of the theory and design of bridges and is meant for the use of degree and diploma students of Civil Engineering. The chapter on design has been completely rewritten in this second and revised edition of the book. Problems have been shifted closer to the relevant theoretical discussions throughout. A major addition in the book has been the chapter on the design of pre-stressed concrete slabs and beams. Pile foundation analysis has been expanded, and illustrative problems have been added to the pile and caissons foundation chapter.

3. **Structural Engineering—2 : Long Span Bridges in Steel.** J. K. Rao. *Dixit Co.*, Bangalore 4, 1963, Rs. 5.00. 116 pages.

This book is intended to meet the needs of senior students of the technical institutions in India. The details of analysis of highway bridges in steel given in this book may be found helpful for application with regard to other types of loadings also. An introductory chapter on plastic theory is included in the book.

4. **A Text-book on Highway Engineering.** K. L. Bhanot and S. B. Sehgal. *S. Chand & Co.*, Ram Nagar, New Delhi, 1963, Rs. 12.50. 392 pages.

The book covers the syllabus of Highway Engineering of Indian Universities. Technical details included in the book are dealt with comprehensively both from the theoretical as well as the practical point of view. Relevent recommendations of the Indian Roads Congress and other similar international bodies have been included in the appropriate chapters. A large number of illustrative problems and diagrams are incorporated. Important questions from various university examinations as well as professional examinations have been included at the end of each chapter for the benefit of students.

5. **Automatic and Semi-Automatic Lathes.** B. L. Boguslavsky. *Foreign Languages Publishing House*, Moscow, 447 pages.

Included in this second revised edition of a book are descriptions of typical up-to-date models of automatic and semi-automatic lathes and automatic transfer machines, as well as instructions for their setting-up and operation. The explanations of complex machine tools given in the book are simple and straightforward.

6. **Engineering Physical Metallurgy.** Prof. Y..Lakhtin. *Foreign Languages Publishing House,* Moscow, 471 pages.

Basic principles of general physical metalurgy, structures of metals, plastic deformation, recrystallization of metals, equilibrium diagrams for binary and ternary systems, the fundamentals involved in the kinetics of phase transformations in metal alloys, as well as the methods employed in the study and testing of metals and their alloys have been dealt with in this book. Comprehensive data on the structure, properties and application of steels, cast irons, non-ferrous metals, and their alloys and a basic understanding of theory and practice in the field of heat-treatment and chemical surface hardening methods are also provided in the book.

7. **Metallurgist's Handbook.** *Foreign Languages Publishing House,* Moscow, 368 pages.

The book contains useful information such as properties of elements and metals chemical composition of cast iron, ferro-alloys and steels of various grades, mechanical properties of various grades of steel, data on assortment of Ferrous Rolled Stock, and data on steel wires. Though mainly meant for metallurgists the book will be useful to practising engineers also.

8. **Handbook of Elementary Physics.** N. Koshkin and M. Shirkevich. *Foreign Languages Publishing House,* Moscow, 214 pages.

The handbook covers all the main topics of elementary physics and contains information most frequently required in industry. Special attention has been paid to the choice of data on the latest developments in physics, such as semi-conductors, ferroelectrics, nuclear physics, etc. In addition to graphs and tables the book offers brief theoretical expositions, definitions of fundamental concepts and formulations of laws accompanied by explanations and examples.

PUBLICATIONS RECEIVED

A copy of the publication entitled 'Classified Handbook of Members 1963' has been received from the British Mechanical Engineering Federation, 32, Victoria Street, London, S.W. 1, in this office. It is an annual Classified Handbook of members of the Federation, their manufactures, trade names and trade marks.

A copy 'Benn's Far-East Directory and Buyers' Guide to British Industry 1963' has been received from Benn's Far-East Directory and Buyers' Guide to British Industry, Bouverie House, 154 Fleet Street, London, E.C. 4. This Directory contains a list of British firms and their far-eastern agents, and a trade mark section.

A copy each of the publications entitled C.W. & P. C. Administration Report (April 1956 to March 1957) and C. W. & P. C. Administration Report (April 1957 to March 1958) have been received from the Central Water & Power Commission, Ministry of Irrigation & Power, Government of India, New Delhi. These publications contain the work done by the Water Wing, Flood Wing and Power Wing of the Central Water and Power Commission during the years under report.

A copy of the publication entitled 'Report of the Indian Productivity Team on Cable Industry 1962' has been received. This report deals with the Cable Industry in general and its position in Japan and the U.S.A. in particular, in all its aspects from factory layout and raw material selection to codes of practice and cable installation methods. It also contains statistical information, tables and charts, illustrations and photographs.

A copy of the publication entitled 'Bibliography on Pile Foundation' has been received from the Central Building Research Institution, Roorkee. This publication prepared by the Information Division of the Central Building Research Institute, is a supplement to the annotated bibliography in pile foundation issued in 1962. It contains further references of papers presented at the symposium on 'Bearing Capacity of Piles' held at the Central Building Research Institute in February 1964.

A copy of the publication entitled 'First Report 1962' of the Calcutta Metropolitan Planning Organization has been received from the Calcutta Metropolitan Planning Organization, (C.M.P.O.) 1 Garstin Place, Calcutta 1. The report deals with the problems of Calcutta with particular reference to housing, slum clearance, water supply, and traffic and transportation and suggests remedies to these. The plan for a satellite town and the plan for a work-*cum*-living centre and middle and low income housing of the C.M.P.O. are also given.

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, **The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.**

SITUATIONS VACANT

M. N. DASTUR & CO. PRIVATE LTD., invite applications from qualified Mechanical Engineers having at least three years' drawing office experience in piping system design, preferably in steel, chemical or power plants. Salary commensurate with qualificaions and experience. Applications stating age, qualifications, experience, etc., should reach the Company at P-17, Mission Row Extension, Calcutta 13, within 10 days of publication of this advertisement.

SITUATIONS WANTED

YOUNG ENGINEER, Diploma Holder in Mechanical and Electrical Engineering, 7 years practical experience in the maintenance, overhauling, and installation of engines, compressors, pumps, cranes, hydraulic and pneumatic machines and different types of machine tools, worked with a reputed British firm and now working in an American concern as engineer, seeks change. (Office ref. E.S. 152)

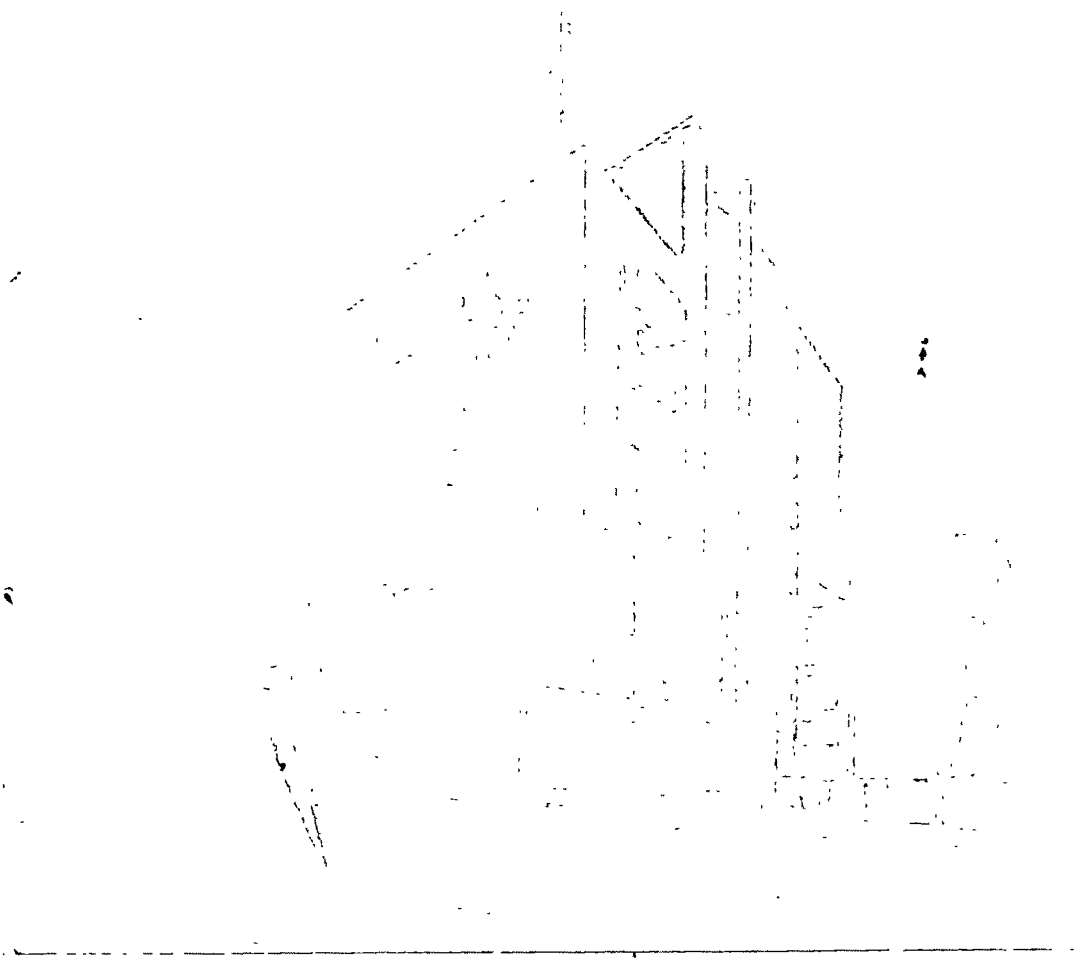
YOUNG ENGINEER, B.Sc., passed Sections A and B of the Associate Membership Examination of the Institution of Engineers (India), 7 years practical experience in maintenance, overhauling and installation of engines, compressors, pumps, cranes, hydraulic and pneumatic tools, different types of machine tools, heavy earthmoving machineries, etc.; worked with a British engineering concern and presently working as Assistant Executive Engineer in a reputable firm; seeks suitable change. (Office ref. E.S. 153)

FIRST CLASS Electrical Engineering Graduate, Grad. I.T.E., A.M.I.E., with eight years of industrial experience including foreign training, desires a change to an industry preferably in the Electronics field. Teaching experience and good working knowledge of German additional qualifications. Available for service from August 1, 1964. (Office ref. E.S. 154)

NEW BUILDING FOR THE HEADQUARTERS OF THE INSTITUTION —AN APPEAL TO MEMBERS

Counting the years that have gone by and the progressive years that lie ahead, the Institution has started on an interesting march in the year 1964.

A new project is now on hand to solve a vexing problem—the serious deficit of essential accommodation for carrying out the functions the profession has been demanding—and the grounds of the Headquarters are resounding with the din and clatter of machinery and men. This is the preliminary for a new phase of construction work which is yet to commence—the building of a 9-storey structure (as seen in the artist's impression given below) that is to be the future home for the Headquarters.



An artist's impression of the proposed building for the Headquarters of the Institution

The aim of this new facility is purposeful—to be able to provide efficient service and to add to the prestige and effectiveness of the country's engineering advance as a whole and thus to its cooperative strength.

The architects of the building are Ballardie, Thompson and Matthews of Calcutta, one of India's leading architectural firms and pioneers in this field.

On the evening of Saturday, October 19, 1963, the site wore a festive and colourful look, with distinguished guests, well-wishers and friends bound in goodwill and common allegiance to the faith and values for which the Institution stands ; and the function that drew this big crowd was the Foundation Stone Laying Ceremony for the new building.

As a commencement of the schedule that has been laid out for this activity, the first of the 148 Simplex piles (which work has been entrusted to Messrs. Simplex Concrete Piles (India) Private, Ltd.) was struck at 10.40 a.m. on March 4, 1964, on a signal given by Shri Akshoy Bose, Senior Partner of Ballardie, Thompson and Matthews, who was a member of the Council for many years and a former Chairman of the Civil Engineering Division and whose record of service to the Institution over two decades is too well known for recounting here.

The new building will be of nine floors, and space has been carefully planned for the requirements of the various Departments of the Headquarters to meet their immediate and foreseeable needs for the next few years. The total floor area will be made up of: office 26,318 sq. ft., utilities 10,270 sq. ft., and a covered car park on ground floor 3,295 sq. ft. The total height of the building will be 108 ft. 6½ in. The estimated cost of the construction is Rs. 15 lakhs.

The foundation work is expected to commence shortly after the piling work is over, and the entire project is scheduled to be ready for final occupancy by December 1965.

To bring this home into a reality, it has now become necessary for the Institution to engage itself in a major fund-raising venture. The project represents a considerable investment in money and materials. The Institution alone cannot do much to help itself unless its economy regains steam through massive support from the Government, the industries and members. The need for this has never been more urgent, but the will to meet the challenge has rarely been stronger. There is still a long way to go ; this perforce is a cooperative endeavour—it compels a pledge to contribute from both within and without the sphere of Institution's influence.

The building can take shape if every member, unified as a whole, makes an individuals gift—to support this significant project which symbolizes the strength and unity of the profession, and stands as a source of pride to those who have helped to build it.

With this note and appeal, the Institution through its Headquarters Building Committee solicits your help and welcomes any financial contribution from you to this Building Fund. **YOUR CONTRIBUTION WILL BE GRATEFULLY RECEIVED.**

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THE BULLETIN
OF
The Institution of Engineers (India)

SECRETARY & EDITOR: B. SESHADRI, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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FARAKKA BARRAGE PROJECT*

R. B. Chakravarty

Member

At the very outset it may be mentioned that all the aspects of a project of the magnitude and complexity as the Farakka Barrage Project can hardly be described within the short space at our disposal. It has taken about a century to feel the necessity of the Project and several decades to give it a shape. We shall, therefore, restrict ourselves to only the technical aspects of the problem rather than its history, background and benefits.

2. The Project aims at supplying a good quantity of comparatively silt-free water on a perennial basis into the Bhagirathi, condition in which is deteriorating fast, owing to its entrance head being silted up to such an extent as it cannot draw except during the flood months. The obvious solution lies in the construction of a barrage across the Ganga, so that the water level in the same could be headed up to the required level for feeding the Bhagirathi, through a link canal connecting its upper reaches with the Ganga.

3. The Project, therefore, mainly consists of a barrage across the Ganga at Farakka and a feeder canal from Farakka to Jangipur with head and tail regulators at the two places respectively. There will also be a barrage, of the type of a regulator, across the Bhagirathi just upstream of the outfall of the feeder canal. There will be navigation locks for movement of vessels between the feeder canal and the Ganga, both upstream and downstream of the barrage at Farakka, as also for movement between feeder canal and the Bhagirathi at Jangipur, both upstream and downstream of the barrage at Jangipur.

4. The barrage will consist of 108 gated openings each of 60 ft. span, with distance of approximately 7,500 ft. between the abutments. 18 of the openings on the right bank (undersluice) will have lower sill with gates 25 ft. high while, the remaining openings will have sill 5 ft. higher and gates 20 ft. high. The piers in between the openings will support bridges to take double line broad gauge railway as also the National Highway. The whole structure will rest on a reinforced concrete raft foundation running from abutment to abutment, of course with necessary contraction joints. The foundation floor will have a profile suitable for dissipation of surplus energy of water flowing through the barrage openings. The undermining of the foundation, resulting from subsoil water flow, will be taken care of by 4 lines of interlocked steel sheet piles running parallel to the axis of the structure. There will also be transverse sheet pile lines to restrict the sub-soil cross flow to limited widths. The transverse pile lines will incidentally limit the extent of damage in case of accidental failure of a part of the structure.

5. There will be a dividing wall partitioning the undersluice channel from the rest of the structure to prevent cross flows (due to difference in the sill levels) coming too near the piers. The raft foundation will be protected against scour coming near it by

---

* Talk delivered at the Bengal Centre of the Institution

launching aprons of cement concrete blocks and stone boulders, both on the upstream and downstream side. On the downstream side, immediately adjoining the raft foundation, there will be an inverted filter covered with cement concrete blocks for release of subsoil flow. The design of the sheet pile lines will be so made as would withstand the difference in soil pressure underneath the structure and outside, should scours come near the structure. The R. C. apron, *i.e.*, the raft foundation will be given proper width not only from point of view of dissipation of surplus energy of surface flow but also for reducing subsoil pressure gradient (at the exit outside the downstream sheet pile line) sufficiently, as not to disturb the bed material immediately on the downstream by what is known as boiling of soil.

6. Guide banks will lead the flow from the wide spill area on the upstream side to the barrage width in between the abutments. Earthen dykes (afflux bunds) will anchor the barrage abutments with high grounds. The afflux bund on the left bank side which will run almost up to the town of Maldah (some 25 miles from Farakka) will have gated openings for release of spill flow at suitable places. A design flood of 27 lakhs cusecs would be routed (without encroaching the free-board) as against the recorded high flood discharge about 20 lakhs cusecs.

7. The head regulators for Feeder Canal, which will consist of 11 gated spans of 40 ft. each, will have a drawing capacity of about 40,000 cusecs. The question of provision of silt excluder at the head regulators is under examination.

8. The navigation locks will be approximately 480 ft.×82 ft. which will accommodate the latest maximum sizes of inland vessels used in this part of the country.

9. The feeder canal will have a bed width of about 500 ft. and side slopes approximately 2½ to 1. Experiments are in progress to find out as to which portions of the canal would need rip rap protection on its sides.

10. The barrage across the Bhagirathi at Jangipur will really be a regulator which would be designed for drawing a maximum of one lakh cusecs directly from the Ganga when necessary during the monsoon. There will also be arrangement for back flushing the portion of the Bhagirathi upstream of Jangipur Barrage from the feeder canal.

11. While the construction of other structures are not expected to raise abnormal difficulties, the construction of the Farakka Barrage is bound to involve several problems. Since it would not be feasible to divert the river flow permanently during the whole of the construction period of 6 years, it has been planned to take up the constructions season-wise within the respective coffer dams to be set up and withdrawn successively each year Here again, difficulty would arise owing to the depth of water in the river which the coffer dams will have to withstand. Construction of 3 bays adjoining the right bank as also of 22 bays on the left bank may be made within simple type coffer dams, as the bed level at such places is comparatively high. But the problem will be difficult in respect of the central part of the constructions consisting of 83 bays, where the river is deep and such depth will be further increased as constructions progress. (Construction from the left bank will have to be limited to 22 bays only as otherwise, scour in the unconstructed portion of the river after the 3rd and 4th years of construction would be too deep for any coffer dam to be constructed.) Studies are

in progress for finding out suitable design of coffer dams. Whatever design is accepted, the coffer dams will be the most difficult items of construction, not only in view of the difficult nature of the problem but also for the short time that will be available for such constructions in each season. In case, the coffer dams are to be constructed and withdrawn during each working season in between monsoon months, the time available for constructing the coffer dams, (which would normally have a total length of 10,000 ft. or so) during peak years of construction will have to be limited to about 40 or 45 days. There is a suggestion, therefore, that submersible type of coffer dams may be constructed so that the coffer dam required for a particular year may be constructed during the previous year and left to submersion during the flood season intervening. This will enable more time for construction, but as such these coffer dams will obstruct a good part of the river flow during floods, the practicability will have to be studied thoroughly before finalizing the design.

12. The excavation of the foundation bed is proposed to be made by suction dredgers which are the most suited equipments for such works. The use of suction dredgers would enable excavation being started along with the progress of construction of the coffer dam. With dredgers excavations may be made under water and therefore this will reduce the period of pumping considerably.

13. Dewatering is proposed to be a combination of surface pumping and subsoil pumping. After the coffer dam in a particular working season is closed, pumps mounted on pontoons will come in operation straightaway, for lowering the water level within the coffer dam. Ground pumping stations will also be set up at suitable places. Lowering of water level by surface pumping will be continued up to about 15 ft. above the foundation level when most of the unexcavated portion of the river bed inside the coffer dam will be exposed dry. Wellpoint system of dewatering foundation soil will then be sunk and operated for draining the foundation pockets in successive parts. (It may be mentioned that with the help of one of the enterprising pump manufacturers in this country, it has been possible to manufacture the necessary wellpoint equipment for the first time in this country. This will not only help in reducing foreign exchange expenditure but will also remove much headache for spare parts and replacement during the construction period). The use of wellpoints for draining the foundation soil will not only eliminate soil movement in foundation during construction but in a way would help to consolidate the soil by the down flow of subsoil water.

14. During the peak working years when the coffer dams will be in the centre of the river, the total pumping is estimated to be over 300 cusecs, which will be continued day and night during the whole of the working season. The movement of concrete and material to the respective coffer dams will be a major problem. Transport arrangements in respect of island coffer dams will consist of barges and tugs, as cableways and other systems are not feasible under such conditions. Attempts will be made to construct the road bridge simultaneously (with precast girders) so that it may serve as the second line of communication at least for the later part of each construction season. All the materials will have to be collected from the right bank, and therefore to meet the requirement of construction on the left bank, wagon-ferry is being arranged. For

work in such coffer dams, as may remain connected with the banks, batching plants will be set up on banks and dry material will be loaded into hydraulic truck mixers which will mix and transport the concrete to the site.

15. The plant layout for concreting for island coffer dams has still not been finalized. Batching plants may be set up on the banks of the river or at edge of coffer dams or on barges.

16. Sheet piles will be driven in most cases by diesel operated pile driving hammers which would do away with boilers or air compressors. Sheet piles used in the construction of coffer dams will be extracted also mostly by diesel operated extractors. The diesel hammers and extractors are not only very economical but are very convenient for such difficult locations.

17. The main quarry is being developed at Barharwa, where a railway siding with marshalling yard is under construction. Two sets of stone crushing plants consisting of gyratory type primary crusher and cone type secondary crusher will be installed having a total capacity of about 300 tons per hr. In addition, maximum advantage will be taken of manual labour in hand-breaking of ballast, spawls and boulders. The movement of material from the quarry to the right bank of the barrage site will be by rail as also by road. Stone material will also be procured from quarries on river bank and transported by barges and country-boats. One major difficulty will be the procurement of sand required for the constructions. The Ganga sand is very fine and contains mica and accordingly, concrete made with this sand will not produce sufficient strength unless the quantity of cement is increased considerably. It is, therefore, proposed to use a mixture of coarse sand (to be brought from Bansloi river at a distance of 50 miles) with Ganga sand in requisite proportions.

18. The barrage is scheduled to be constructed in seven coffer dams covering a period of five years. Another year will be required to complete the bridge and approaches. The total concreting to be done in the barrage itself is 225 lakh cu.ft. and during a peak construction year, the quantity will be 55 lakh cu.ft. The net concreting time in a working season (in between the construction and withdrawal of coffer dams) after allowing time for dredging, dewatering, trimming of foundation, sheet-piling, etc., will only be about 70 days. Thus the average rate during peak working season will be approximately 80,000 cu.ft. per day and maximum will be still more. In addition, daily average of rip rap work will be 80,000 cu.ft. The difficulty will be particularly in view of unfavourable conditions within the coffer dams, where all the material will have to be transported by barges, etc., and double-handled at the edge of the coffer dam.

19. Alternative sources of power will be arranged independently on both banks as damages from inundation during even short period breakdowns of electricity can be better imagined than described. For the right bank side steam packaged plants (3,000 kVA) are being set up. High tension transmission line from the Berhampur grid is also being arranged as supplementary and stand by arrangement. For the left bank side, proposals are still under examination.

20. The feeder canal traverses an area having fairly high subsoil water level, but this will not create much difficulty as here again cutter suction dredgers will be used for the wet soil.

21. Two marginal dykes will be constructed on the left bank of the canal and the soil dredged from the feeder canal will be deposited in the space between the dykes. On the right bank a flood embankment will be constructed, over which the Eastern Railway line connecting Jangipur and Tildanga will be shifted. The feeder canal will have a capacity of 40,000 cusecs although the quantity to be drawn into the canal will be regulated according to the necessity and availability of water in the Ganga.

SHOULD ENGINEERING CURRICULUM INCLUDE ENGINEERING JURISPRUDENCE ?

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'Ignorance of law is no excuse' is the law with which each one of us has been confronted some time or other in our lives. For the smooth running of society, it is desirable that its members are familiar with and abide by the laws. But, there are certain professions where knowledge of certain laws is undoubtedly a necessity. Generally speaking, these professions are the ones that involve contact with the public, and engineering is undoubtedly one of them. Leaving aside an insignificant minority, all engineers deal with men ; but their curriculum does not contain a well defined subject of engineering jurisprudence as such.

When medical graduates can have a paper on medical jurisprudence in their course, it stands to reason that engineering graduates should have one on engineering jurisprudence. There are certain laws relating to, labour and contracts with which all engineers should be conversant since they have to deal with labour and sign contracts for execution of works more frequently than anybody else in the discharge of their professional duties. Further, they should not be ignorant about laws relating to appropriation (and misappropriation) of money, accounting, etc.

Then there are laws special to different branches, like Electricity Act for electrical engineers, Factories Act, Boiler Act, etc., for mechanical engineers and the like. These are discussed here and there during the course, but do not get the attention they deserve. A reorganization of curriculum so as to have a separate paper on engineering jurisprudence covering laws of common interest as a must and special laws as optionals for different branches appears desirable.

An argument that could be put forth against this suggested scheme is that engineers are given this training during the course of their service. For example, those who work in government departments have to pass departmental examinations periodically. True, but this type of argument only reveals the ignorance of the problem. There is a fundamental difference between the training and departmental examinations referred to above and the teaching of engineering jurisprudence as part of the course. Academic study gives an insight into the subject which the training fails to provide. What the engineers get acquainted with during training is the code of practices followed in a particular department, rather than the legal aspects of the same. It could only compare with the post graduation apprenticeship training necessary for learning the practical aspects before an engineer can be considered as professionally competent to take charge of a responsible job.

These days there is a tendency to increase the scientific content of engineering curriculum to be in line with the practice in western countries. But we have to remember the different conditions in which most of our engineers work. There is little opportunity of their using the advanced theories learnt at college, at least in the initial stages of their professional career. A course in engineering jurisprudence is likely to be more useful to them under the present conditions. By this we do not mean that the increase of scientific content in the curriculum is undesirable. It is certainly good, but only when the conditions are altered so as to permit 'proper utilization' of the engineers who possess that knowledge.

It is common practice to have non-engineers at the head of big engineering projects. One reason why engineers are not considered suitable for these jobs is their ignorance of legal aspects. Having no background of jurisprudence and being busy with technical matters, they develop a sort of complex against anything involving legal intricacies which in turn closes the door to their occupying top administrative posts even in engineering projects. This is not only against their own interest, but against the interests of the project. An engineer-administrator has better understanding of the problems. With engineering background, his decisions are bound to be better for the engineering project than those of his purely administrative counterparts.

Thus we see that the points in favour of having a course on engineering jurisprudence in engineering curriculum as outlined above are sufficiently numerous and strong to justify its inclusion.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Kerala Centre

Chairman's address by Shri V. Ranganathan, M.I.E., at the 17th Annual General Meeting of the Centre on January 26, 1964.

After welcoming the Chief Guest, Dr. V. V. Giri, Governor of Kerala, and other invitees, Shri Ranganathan thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering the Chairman's address, he said, 'My professional career has been almost fully that of a hydraulic engineer and in the wake of Independence with the many irrigation and hydroelectric schemes taking shape under the continuing Five Year Plans, the hydraulic engineer has been called upon to play an important role in the developmental activities of the country. In our own small State of Kerala also, the biggest single item of natural resources is its water potential and the hydraulic engineer has necessarily and naturally to play a vital and strategic role. In this background, I hope you will excuse me if I attempt to share with you some of my own thoughts regarding the water resources of Kerala and their development.

Kerala is blessed with 44 rivers draining their rainy and wooded catchments into the sea, the total annual run off being estimated at about 2,500 thousand million cu.ft. Only a small fraction of this flow is at present utilized for irrigation and power, and other purposes. Outstanding among all these rivers is the Periyar which, though second in length to Bharatapuzha, has the biggest annual run off of 435 thousand million cu.ft. Due to the peculiar topography of the land through which the river flows, Periyar has also the biggest hydro power potential among the rivers of Kerala. Its Mudirapuzha arm draining mostly the Kannan Devan Hill Reserve area has been the first to be exploited for hydro power development in Kerala. Four of the five existing power stations feeding the Kerala grid now, *viz.*, Pallivasal, Sengulam, Neriamangalam and Panniar are in the Mudirapuzha valley. There is scope for yet another independent power station, The Lakshmi to utilize the untapped resources of the Upper Mudirapuzha catchment and the tail waters of which can be utilized to increase production at Sengulam and Neriamangalam stations. In the ultimate picture, the Mudirapuzha arm of the Periyar alone will contribute about 360 MW of power at 60% load factor to the Kerala grid and discharge a continuous flow of 925 cusecs into the Periyar at its confluence with the main Periyar coming from the south

Now the second major arm of the Periyar is the one in which Idikki is situated. The top 250 sq. miles of catchment of this arm of Periyar has already been exploited by the neighbouring State of Madras as early as in the closing decade of the last century by diversion for irrigation in the Madurai district and subsequently for development of power also under what is known as the Periyar Hydro Electric Scheme. The Idikki Hydro Electric Scheme as at present visualised proposes the creation of the biggest reservoir in our State with a gross capacity of 59.8 thousand million cu.ft. by constructing two high dams, one across Periyar at the Idikki gorge and another across Cheruthoni a close tributary and a few dykes. The huge storage will control the entire yield of Periyar from its catchment above Idikki and much more. This yield will ensure a firm draft of 1440 cusecs which is proposed to be diverted to the neighbouring Muvattupuzha valley by means of a 1.75 mile long tunnel to produce firm power. to the extent of 355 MW at 60% load factor over an average gross head of 2170 ft. With the installation of machines to ensure 30% load factor when completed, the Idikki Power Station is to be one of the biggest single power stations in India.

Another significant arm of the Periyar joins it before Mudirapuzha is the Perinkajutty river which drains about 154 sq. miles of the Cardamom Reserve in the Devicolam, Udumbanchola, Peermade Taluks of Kottayam district contributing an annual yield of about 20 thousand million cu. ft. to mother Periyar. Various modes of power devlopment in this sub-basin have also been investigated in the past. In keeping with the pattern current during those days, in all the different alternatives investigated, even this sub-basin was taken as an individual basin and modes of development studied accordingly. With the new conception of valley wise development and inter-basin transfer of waters for optimum benefits about which I had occasion to mention before, a new pattern of development of this sub-basin was suggested.

Mention has been made in the Idikki Project Report regarding the possibilities of diverting the waters of Kallar and Rettayar to the Idikki reservoir to be utilised over the available average gross head of 2170 ft. under that Scheme. Since the potential of the waters under Idikki will be nearly 500 ft. more than under Perinjakutty, considering tail race utilisation under lower Periyar also, the attractiveness of the proposals was obvious. At the same time with the diversion of this sizable yield amounting to 11.5 thousand million cu. ft. corresponding to 360 cusecs to Idikki reservoir, the balance yield of about 7 thousand million cu. ft. can ensure only a firm draft of about 220 cusecs for Perinkajutty. This led to the exploration of the possibilities of diverting waters in replacement to this valley from other neighbouring valleys where the waters may have only a lesser potential. At the same time it was seen that by lowering the draw down level of the power tunnel under Idikki, the live storage of this big reservoir could be increased by as much as 53% with only an increase in the cost of the tunnel on account of its increased length. This also was likely to be offset by avoiding the high earthen dam at Kulamavu which would be necessary if the high draw down level were to be retained. It is well known to every hydraulic engineer that reservoir space is costly. As such, the clear possibility of obtaining as much as 18 thousand million cu. ft. additional storage without any considerable additional cost is sure to catch the imagination of any engineer. This possibility opened up the rosy vista of increasing the firm draft of Idikki to utilize the attractive head of about 2170 ft., if only sufficient water could be found.

Simultaneous with this welcome unfolding of the vast possibilities of Idikki, another aspect of the problem came to the fore. Diversion of more and more waters to

Idikki Reservoir under the presently conceived pattern of power development under Idikki meant starving Periyar of waters to that extent, since the tail race under the scheme was to be discharged to Muvattupuzha and not Periyar. This created a stir among the industrialists in the Alwaye industrial belt where industries were reported to be already facing a crisis for want of fresh water in summer months. Their voice had necessarily to be heard, as power was not an end in itself but a means to rapid industrialisation. As such, the water requirements of Periyar valley in the lower reaches had to be studied in detail, both from a short and long term point of view and an integrated approach made to the problem of planning for power as well. Ways had to be found to divert back into Periyar itself at least a good portion of the water used for production of power under the Idikki Scheme which certainly deserved all the water that could be diverted to it on account of its very high head.

The three strains of thought mentioned above prompted a thorough study on paper first, and then on the ground of the Periyar basin, with the new concept of long inter-basin transfer of water without shying at the idea of long tunnelling, if only the idea was practical and justifiable by economic comparison. The competitive records set up in tunnelling by our engineers and even local contractors under the Sabarigiri Project which broke all Indian records thrice successively by healthy competition, was a significant source of inspiration in investigating and putting across a modus operandi, which perhaps like all original and new thoughts down the ages, might at first sight sound chimerical.

The result of the studies conducted within the limited time and resources available, has been compiled in the shape of a Master Plan for Power Development in Periyar with special emphasis on the new concept for Idikki termed 'Modified Idikki' with two power stations one at Mollamattom as originally proposed and another on the left bank of the Periyar with practically the same head as at Molamattom, to be fed by a long water conductor system including a 14 mile long tunnel both being fed from the Idikki reservoir according to necessity of water in the respective tail race valleys, *viz.*, Muvattupuzha and Periyar. The 'Modified Idikki' has been so conceived that it will be slightly modified from the sanctioned Idikki but at the same time retaining many of its essential features. It will also fit into Greater Idikki with a firm power draft of 2270 cusecs distributed between the two power stations at Molamattom and Periyar, each with an installed capacity of 600 MW making up a total of 1200 MW. I do not propose to go into the details of this Master Plan nor will it be proper for me to do so in this short address but suffice to say that when completed at an estimated cost of Rs. 158.46 crores at the present day cost, excluding the installations already under construction and in commission, it would consist of six dams (Idikki, Cheruthoni, Periyar, Periyavarai, Lower Kallar and Pooyankutty) possibly all of the arch type or at least three of them of the arch type with a number of diversion weirs and about 90 miles of tunnel, 6 or 7 power stations and other auxiliaries. These will of course include the Lower Periyar Scheme on the Main Periyar below its confluence with Mudirapuzha which forms a tail race scheme of all the schemes in the Mudirapuzha arm as also the Perinkakutty Scheme. It is interesting that the power station stated under this scheme working over a head of nearly 600 ft. for a diversion across main Periyar is proposed to be made integral with the Idikki Periyar Power Station working over a head of over 2,100 ft. with a common structure located on the left bank of Periyar. The Pooyankutty Scheme over a sub tributary of the Periyar of the same name joining Edamalai near Kothamangalam is also included under the Master Plan. Resources permitting, the entire scheme can be put through during the Fourth and the Fifth Plans which may well be a decade of destiny for Kerala.

As already indicated in the beginning, Kerala has quite a number of river valleys and a good number of them have considerable hydro potential though not of the magnitude of the Periyar. These resources also certainly deserve to be harnessed and harnessed quickly too. But unfortunately and correctly too, as has been remarked by one of our eminent leaders, we have not yet learnt the art of speeding up our projects. It is better to have a few projects completed quickly than to have more projects to give satisfaction to politicians. It is on this trend of thought that I have made an attempt here to highlight the possibilities of harnessing the Periyar which can very well be called the Power Engineers' Paradise. With the limited resources available with us, both in terms of money and experienced technical manpower, it would be better to concentrate on a limited number of schemes at a time in a specified area rather than distributing our energies far and wide without achieving any substantial results quickly. Especially, in the case of power, regional considerations are of no avail at all since once the energy flows into the grid, its benefits are available to all consumers connected to the grid.

I have ventured to place before you a few random thoughts which attempt to give a perspective of the immense possibilities as also the vast responsibilities of but one sector of our profession. It has been estimated that the technical manpower requirements in the civil side in the future sector of the Fourth Plan under Power alone for our State will be as follows: Chief Engineers 2, Superintending Engineers 13, Executive Engineers 37, Assistant Engineers 134, Junior Engineers 410, etc.

This sounds unbelievable, but facts are some times stranger than fiction, and they reveal the vast possibilities of our profession. As a matter of fact, every successive Five Year Plan ever since Independence has been a challenge to the engineer to show off his best. We might have lagged behind or faltered once, but we will not be worth the trust reposed on us by the country and its leaders, if we continue faltering and lagging behind. Those of us who have reached almost the fag end of an active service may, henceforward, be only interested and sympathetic spectators. The challenge is primarily thrown to you, the middle and younger strata of engineers, who, I am sure will acquit creditably in the golden days to come.

I wish you all godspeed.

Thank you'.

Mysore Centre

Chairman's address by Shri B. R. Manickam, B.E., M.S., M.A.S., C.E., F.I.T.P., M.I.E., at the 29th Annual General Meeting of the Centre on January 28, 1964.

After welcoming the Chief Guest, Shri Veerendra Patil, Minister for Public Works and other invitees, Shri Manickam thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering the Chairman's address, he said, 'I would like to deal with the subject of Architecture, particularly, about Contemporary Architecture. The word 'contemporary' means 'belonging to the same period'. This term was first applied to architecture in the beginning of the twentieth century. A few bold and enterprising architects broke the tradition, returned to the first principles, analyzed the functions and designed the building without dressing it in styles borrowed from the past. This new style of construction was termed 'Contemporary Architecture', being something entirely different from the majority of the buildings being erected in the same period. Architecture which is defined vaguely as the matrix of civilization reflects the thought of the day, the needs and aspirations of the people and is an index of social forces at work. It depicts the state of society and culture of the period, and any monumental building constructed during a period stands as a land-mark to depict the history of the management who were responsible for erecting, while its architecture represents the aspirations of such a management.

The social upheaval in the midst of which we live is reflected in the haphazard appearance of our towns. We find contemporary buildings that have identical requirements, often dressed in styles borrowed from the past, and professing modernism without an understanding of its technical needs or aesthetic possibilities. It is only in a few buildings we find the real contemporary architecture based on purpose or function and building technique. The purpose of my speech is to describe how the contemporary architectural activity—its growth and the validity of its precepts—lead us once more to the beginning of a genuine tradition.

Until the 19th century, architecture was considered to be only the decoration of a structure—the most appropriate choice and application of styles. But the modern architecture does not confine itself to mere elevation but goes into every detail inside a structure. It is not bound by the tight definition of the ordinary usage of the word 'style'. It is a manifestation of a clear 'approach to design'. Such an approach to design is not of course new. The Egyptians, Indians, Greeks and the Romans had this approach in view while perfecting their designs, the limitation being the then existing 'purpose and technique'. The purpose and technique which are the inescapable controlling factors for all applied art, were very limited then. The problem of design, therefore, was quite simple and after having solved it, they devoted their efforts in perfecting the decoration of structures. In later periods, people merely copied these styles and made the function or the purpose subsidiary to the 'style'. There was really no progress up to 19th century. Particularly, during the 19th century they were so thoroughly over laid with the products of an unduly conceived artistic fancy that they became obscured. But, today the search for visual harmony with the advance in the building technique and materials, particularly, cement, iron and glass has fortunately led us back to the first principles. We find that the formative influences, of function, method and man's attitude of mind are all greatly changed. It is for this reason that modern architecture appears so strange that people put it down sometimes as the stylistic whim of architects striving for mere novelty.

Hitherto, the buildings depended largely on weight-bearing wall construction, the weight of the upper storey being supported on the walls of the ground floor, the thickness of which were determined by the loads they carried. The window and door openings had to be relatively small for want of proper materials for spanning these openings. The height of the building was again restricted, unless the walls in the lower storeys were to be made so massive as to make the lower floors virtually unusable.

The development of steel and reinforced concrete had led to ribbed construction design where walls merely serve as screens for privacy and barriers against the weather and noise. The load is all taken by the frame and the structure therefore is made to look slender and elegant. We need not think any more of massive classical columns. Framed construction has led to 'free planning' which changes the traditional conception of a building as an arrangement of rigidly enclosed rooms. We have therefore the tempting possibility of an internal landscape.

It is no longer necessary to stick to the dogmatism of styles borrowed from the past styles evolved from an entirely different building technique for buildings having very different requirements. We must adopt an architecture fundamentally based on modern life and structure, and make use of the various modern materials of construction for providing us with amenities that the people of the past never thought of. Thus, the design of framed structures, the use of steel and reinforced concrete for large spans and the adoption of a scientific attitude to the choice of materials, are, in themselves, sufficient causes for a revolution in architecture.

Further impetus to this architectural revolution has been given by the changed functions of our buildings. Factories, power stations, office blocks, commercial buildings, auditoriums. Hospitals, community centres, etc., have brought new building types into being. In the past, architecture was mostly confined to churches, temples, mosques and palaces; while now it is applied to almost every building used by the individual or by the society. The human requirements have also changed from a simple arrangement of rooms to a complex structure equipped with electric power, gas, complicated plumbing and air conditioning.

There is always a complaint from the public, particularly those elders who have a great liking for the past styles and orders, that the modern buildings are wanting very much in architectural composition and do not satisfy their hunger for visual delight.

The contemporary architecture demands a scientific understanding, as it derives its beauty from frank and sensitive expression of technique and material. To enjoy it, one must separate from each visual experience, the associations and prejudices which confuse and limit one's perception.

As stated before, the modern architect does not devote his attention merely on elevation treatment. He analyses the functions of each unit without any preconceived ideas, and thinks how best to build up from first principles. The disposition of the various rooms and halls for proper communication, orientation of each room to serve best the purpose for which it is intended, choice of materials for interior fittings and decoration, blending of colours, control of ventilation and light, proper provision for electric and sanitary fittings, fixing of openings with reference to furniture and hundred other problems have to be solved by the architect before he decides the shape and size of the buildings. Then comes the elevation and exterior treatment. Balancing of solids and voids, accentuation of vertical supports (what is known as a vertical treatment) or bold horizontal forms of elegant projected balconies ; window and verandah grouping, introduction of projections for light and shade effect, grouping of masses not giving importance to exaggerated symmetry, are some of his considerations while deciding the elevation. Thus, the exterior decoration as per any accepted style is no criterion in modern design.

Let us now make a comparative study of some important buildings, in Bangalore for clarifying our views. The old Public Offices, for instance, is of 'Late English Rennaisance Style' with pillars following the classical ionic order. This building no doubt looks quite magnificent. The ground floor consists of massive columns and arches with deep cornices. The first floor has double pillars of ionic order, arches, architraves and pediments with deep cornices, all following very rigidly the proportions arrived at by the Greeks and Romans after great experience and and labour, two thousand years ago. There is an exaggerated symmetry in plan, with repetition of the same treatment from one end to the other. It is this repetition of an architectural treatment that was, and is now to a certain extent, influencing the eyes of an ordinary observer, the numerous projections and cornices, the ionic volutes and all decorative symbols do not serve any purpose. They are costly to construct and maintain. They harbour dust. While designing the building the architect has been careful in observing the 'style' and not the functions of the various units. The rooms are unnecessarily high and cannot be lowered, as the proportions would be upset. The walls and pillars are too massive and reduce the usable space. This building built on modern style will cost less, will be better lighted and give greater accommodation.

Let us take *Vidhana Soudha* building for instance. It was built as recently as 1952-56. This building on an Oriental Dravidian Rennaisance depicts a period of upheaval when the rule of the State passed from the Prince to the People. Being the the seat of Government and Legislature, the importance of the palace has disappeared and the traditional old oriental style of architecture, namely, Dravidian style which existed a thousand years ago in the south has been revived, which indicates a period of revival of our old art, our language, music and dance. A modern building built on functional principles would not have depicted this important period of upheavals in the history of Mysore and also the aims and aspirations of the Mysoreans in reviving their old art and culture. Even though people including myself will criticise from the contemporary point of view, the style of architecture adopted for *Vidhana Soudha*, the justification is that it has been built as a monument to depict the important period described above.

Let us take another example, the New Public Offices built on some mixed style approaching Indo-Saracenic style. At least the classic styles have some life in them. But the Saracenic has absolutely no natural expression. It developed purely on arched construction. The arches were decorated to form fantastic shapes. Arch was a necessity as there was no other method of spanning openings. The architraves, pillars, pillasters, etc., are architecturally treated with geometrically shapped life-less figures, either depressed or embossed. Simple repetition of these architectural treatment from one end to the other is supposed to feast the eyes of the observer. Arch is a live enemy in a structure. When we have excellent structural materials like steel and reinforced cement concrete we need not any more think of arches. If the arches disappear with it disappears the Saracenic style.

As a third example let us consider the pure Gothic style of Central College. This style again was developed purely on the type of arched construction as a matter of necessity in the West. The arches are decorated by cornices of beeding type. For tall buildings particularly churches, they had to strengthen the walls with pillasters built as buttresses. These buttresses are decorated with cornices to make them look elegant. We now need neither the gothic arch nor the buttress, with our present technique in construction and advanced building materials. We should, therefore, try to forget the beauty we used to see in a gothic style.

It is most gratifying to note that old Dravidian style did not believe in arches. They have spanned big openings with heavy stone beams perhaps protested for the load it had to carry. They never believed in mortar or any matrix. They built huge temples with nicely dressed stones laid to interlock with each other without any mortar. They believed that mortar was a material that would deteriorate much earlier than stone. In order to maintain their monuments for a long period, they completely avoided mortar. That is the reason why some of the temples are remaining intact in spite of want of care and maintenance. The modern architecture so far as method of spanning openings is concerned approaches Dravidian style.

A great part of the ornament of past periods was in the form of decorative emblems indicating purpose and worth. Today these emblems are largely replaced by the written word; the architect does not have to rely on sculpture to tell a story, indicate a function, or to symbolize an institute's worth. In contemporary style we notice the absence of applied decoration used for the architectural punctuation which was an element of classical architecture, indicating strength, emphasising the joints and capturing the eye. Today, our minds have changed, and with them our attitude to architecture. Decorative symbols have ceased to be valid, and decorative punctuations have been discarded lest the fundamentals of an aesthetic approach be obscured, and with them the whole creative language of architectural ornament, as understood in the past, is dying a natural death.

Having described what contemporary architecture is and how it differs from the past styles, it is now necessary to study the principles underlying the design of buildings intended for different purposes. Our activities having increased, the architect has got to build structures for satisfying numerous needs of modern civilization. The treatise on on contemporary architecture will not be complete without reference to the principles of design of each type of building, such as, domestic houses, hotels and restaurants, parliament houses, town halls, college buildings, schools, office buildings, railway stations, theatres, cinemas, concert halls, recreation buildings, bus shelters, aerodromes, dispensaries, hospitals, etc. It will be seen that in designing any of these buildings it will be necessary on the part of the architect to realise the needs of the people or the agency using the building. In the West, therefore, architects specialise in different branches. There are architects specialised in school design, in hospital design, in office design, in the design of apartment houses, etc. This specialisation is necessary because one cannot master the various needs of all the branches of modern civilization. In the design of hospitals, for instance, it is necessary for the architect to have a working knowledge of medical science, as regards the needs of accommodation for the treatment of various diseases. A dental clinic will be entirely different from ordinary surgical unit or a venereal clinic. A mental hospital will have to be designed in absolutely a different way than a sanatorium. It is here that the contemporary architect is different from those of the past, in that he has to get into the fundamental of design to satisfy the needs of each branch.

It is not possible to describe in this speech all the buildings, mentioned above. We shall take, as an example, 'domestic architecture', that is, how we go about designing a house comfortable for a family to live. As has already been stated the principles underlying design include clarity of purpose and unity of expression. By clarity is implied the solution of a problem in the simplest manner without the slightest trace of confusion. By unity is meant observance of scale and the harmonising of diverse elements. In domestic architecture, for instance, we can divide a house into three parts, namely, 'reception', 'sleeping', and 'service quarters'. The aim of a contemporary architect therefore is to co-ordinate these sub-divisons under a general scheme of privacy.

With the use of reinforced concrete and steel it has been possible to design houses with large spans giving the required enclosed space which could be used in any manner that an individual may like. This tendency known as 'free planning' which has come to the westerners as revelation today was to a certain extent, followed by our Indian ancestors. Take for instance the *thotti*-type house. It is a house with an open courtyard in the centre. The house was built invariably on a ribbed frame design. The frames were made up of wood which was available in plenty in good old a days. The walls were merely partitions made up of either mud or *thotti*-walls. Such structures have stood for ages as the strength depended on the strength of wooden frame and not on walls and foundations. Even today many houses in the Mysore city which have developed several cracks in the walls are standing intact, even though they are several hundreds of years old.

The subject of free plannings as been very eminently dealt with by those pioneers who thought of this *thotti*-type houses. Round the open courtyard is a covered verandah and round this verandah are the halls and rooms with partitions which could be changed in any manner on individual needs. Now Mies van der Rohe, Le Corbusier and Jeanneret have thought of this type of free planning. This freedom of planning by creating an enclosed space to be put to any desired use as per actual needs was therefore thought of by our ancestors several hundreds of years ago. Thus, contemporary architecture in planning domestic buildings aims at spaciousness, or the free plan—a conception realised long ago by Indians.

Nineteenth century houses, and in fact majority of houses now built, can be divided into two parts, *viz.*, the 'open space' and the 'built-up-area'. The building is made a self-contained unit generally located in the middle of the site with open space all round. As has already been said the built up area is divided into three parts on functional basis—*viz.*, (1) 'reception' which does not require much of privacy, (2) 'sleeping' which requires privacy, and (3) 'service rooms' like kitchen store, bath, etc., which require partial privacy with access from outside for services. The aim of the modern architect is to co-ordinate these three sub-divisions under a general scheme of privacy taking the landscape in. He no longer views the open area and built up area separately. He tries hard to break up the monotony of living inside four walls. He brings nature consisting of lawns, plants and trees inside the house. In other words, the house is not designed to look as a magnificent mansion but as a part and parcel of nature. This type of house is not common in India, as it is very inconvenient from the point of view of safety. We want compact units for locking ourselves in. We are afraid of taking the open space inside the built up area. It may be remembered here that our ancestors had solved this problem in their own way by taking the open area inside the building a *thotti*-type house. Here again we see that they had the contemporary outlook in designing their houses.

A lot of time and energy has been spent in designing flats and apartment houses in the West. Excepting in Bombay, Calcutta and a few busy towns, this flat system is not very popular in India. In Mysore, however, we have not come to such a stage when there would be need for many families to live under the same roof. It is absolutely unnecessary to get into this muddle of building skyscrappers or multi-storeyed domestic buildings with flats. This is all due to ill planning. No city need grow beyond a certain limit. Proper master planning can easily control growth of these towns. Westerners, particularly, Americans have realised the folly of allowing their towns to grow without any planning and they are now trying their endeavour to disperse the population and to reduce the towns to a manageable size. We, in India, are just entering the industrial revolution and we can prevent effectively, from the experience so far gained by the world, the growth of these towns into unmanageable sizes. This requires a separate chapter on principles of planning. Suffice it to say that under contemporary design, we need not now dwell on apartment houses.

To understand more about contemporary architecture one has to study the principles underlying the design of each type of building, as we have done under 'domestic architecture'. It is nothing new; but it had been obscured under the influence of styles. We may conclude by saying that a contemporary architect has to go to the first principles, analyse the functions of various units and co-ordinate them in the most economical and efficient way for comfortable and happy living or for the best use of space, without paying much attention to the so-called styles of the past which developed under entirely different conditions. This is similar to a mathematician arriving at the solution of a problem from first principles and not from mugged-up formulæ derived by others.

Now, I would like to say something about the role of engineers in the development of the country and the treatment meted out to them. Having been in-charge of engineering administration for the past three years, I should bring home certain facts to this august gathering of engineers. People speak very high of engineers and engineering profession and also stress the important role that engineer has to play in the development of a country. But, at the same time a few of them cast aspersions on the engineers and decry them. It is our unfortunate lot that we should get kicks after having toiled and contributed to the development of the country. They extract work from us and they kick us also at the back. The other day for instance, there was a big column with head lines in the papers saying that 'P.W.D. defies Constituion' on the findings of the Public Account Committee regarding the various irregularities committed by the Public Works Department.

This pained me and my engineering friends very much. I was wondering who was responsible for these irregularities. It was stated that the provisions made in the budget estimates were exceeded, unsanctioned works executed, sanctioned works not commenced and grants provided were lapsed and so on. These irregularities are on account of not the carelessness on the part of the engineers, but it is due to defective budgetting in democratic set up. In the anxiety to develop our State, people in power, legislators and others include in the budget estimates items of works not investigated. They include works costing several lakhs of rupees and provide a token grant. Persons with authority induce the engineers to start works pending sanction. Some times they lay the foundation stone for works which are not sanctioned. Grants are not intimated in time. Often additional grants are given at the fag end of the year. These are the causes for the various irregularities. The remedy lies in framing a budget with an outlook of reality. No unsanctioned works to be included in the budget; adequate grants should be provided for sanctioned works; no pressure is brought on the engineers to start works pending sanction; a regular programme is drawn up on priority basis and investigations made for preparing correct estimates of works. These will not only prevent the irregularities, but will result in economy and control on the expenditure and stabilise our finances. Well, it was my desire to express my deep sense of feelings when I read the bold head lines 'PW.D. defies Constitution'. Some years ago they called P.W.D. as enemy no. 1. Some were describing P.W.D. as a 'Public Waste Department'. My dear Engineers, don't you think such statements pain us? Don't you think that we do not deserve such a treatment after sincerely serving the State or the country for its development? I wanted to make these statements before our Minister for Public Works, who should protect the interest and welfare of the engineers.

In conclusion, may I put some facts before our Public Works Minister regarding the needs of the Mysore Centre of the Institution of Engineers, With the help of the Mysore Government by way of sanctioning the site and giving a munificient grant of Rs. 1 lakh, we have put up this big building in which we are gathered today. We have not been able to complete the building for want of funds. The Centre has already given Rs. 95,000. It has not been possible for them to give anything more. We have collected over a lakh of rupees from engineers, engineering firms and contractors. In spite of all this we have not been able to complete the building, which requires another 1 lakh of rupees for finishing works. Our library hall has been designed with very great ambition. It can hold 50,000 volumes. But we have hardly 1,000 volumes. We require several lakhs of rupees worth of books to fill the library. Thanks to Shri Ramnarayan Chellaram who has opened his Book Bank in the premises. After amalgamation of Mysore Engineers Association, we will get all their books into our library. Still we will be short of books.

May I take this opportunity to request our Public Works Minister to be good enough to move the Government to give us an additional grant of Rs. 50,000 for completing the building and Rs. 1 lakh for purchase of books for our library as requested last year ? With these words, I conclude after thanking you for having attended our function. I wish you all a very happy and prosperous New Year in 1964'.

Summaries of Papers Published in the Journal, vol. 44, no. 9, pts. CI 5, ME 5 and ET 3, May 1964

CIVIL ENGINEERING DIVISION

Soil Structure and Strength Characteristics of Compacted Clay under Vibratory Loading

T. S. Nagaraj

Non-member

In this paper, the strength characteristics of compacted clay subject to vibratory loading of a definite ratio of dynamic to static stress intensity at constant frequency, keeping the initial soil structure either flocculent or dispersed are studied. The initial soil structure is chiefly governed by the moulding water content and hence the dry density and corresponding moisture contents are fixed up from the known water content and dry density relationships of the clay. Further, these investigations were carried out even for the optimum moisture content. A general study of the strength parameters for various conditions signifies the influence of initial soil structure on the strength of compacted clays under vibratory loading. This investigation will be of some use in machine foundation problems and also in the design of runway and highway pavements subjected to repetitional loading.

Ultimate Strength of Reinforced Concrete Portal Frames

R. Nagaraja
Non-member

Statically indeterminate structures when loaded show a considerable reserve of strength above the elastic stage and up to the point of incipient failure. After the formation of the first plastic hinge in the structure, the increase in the moment at the section is transferred through the hinges to less highly stressed critical sections, the hinge itself undergoing considerable rotations at more or less constant moment. Due to this moment transfer more plastic hinges develop at other critical sections till a failure mechanism is formed.

Studies on Stress Distribution Around Underground Surge Tanks in Relation to Structural Design

B. Pant
Associate Member
and
S. S. Patel
Non-member

Several difficulties in three-dimensional stress analysis of underground surge tanks gave tended designers to depend solely on the experience of the previous structures and to the adoption of similar structural design irrespective of local conditions. This naturally leads on the one hand to uneconomical use of structural materials when the conditions are good, and on the other to serious structural hazards when the conditions are poor. Analytical and three-dimensional photoelastic studies carried out by the authors have thrown some light into the mechanism of the stress formation around these underground structures. Study of these results have led to the formulation of a simple theory with the aid of which the main features of stress distribution could be obtained in a short time. Graphs are presented to assist the design analysis. A procedure for design analysis is given. Although the theory is necessarily approximate and based on elastic behaviour of materials, it would assist the designer to analyse high streses and to assess the effects of the various factors involved in the optimum design such as rock support, end restraint, size and shape of openings, and thus to arrive at safer and more economical structures.

MECHANICAL ENGINEERING DIVISION

Machineability of Mild Steel with High Speed Steel Tool

M. L. Mathur
Associate Member
and
J. L. Batra
Associate Member

An attempt is made in this paper to present machining/turning characteristics of low carbon steel with a single-point high speed steel tool having RC No. 46. Experiments were conducted by varying the tool geometry and cutting speed. The results so obtained are tabulated and some graphs plotted from these experimental results.

INDUSTRIAL ENGINEERING GROUP

Optimal Machine Allocation

S. C. Jain
Non-member

Dr. S. N. N. Pandit
Non-member

and

Prof. R. Mishra
Member

The problem of assigning different jobs to different machines in the best possible way is a common enough problem industrial engineering and management to demand a systematic investigation for its solution. Like all practical management problems in general, there are three aspects to this problem in any given context : (i) formulation of the problem, including the statement of the objective in an explicit manner, (ii) collection and analysis of the relevant data, and (iii) solution of the problem on and, on the basis of such data, by using suitable mathematical or other techniques.

Machine Interference

N. V. Krishna
Non-member

and

Prof. N. K. Datta
Associate Member

A knowledge of the effects of interference will be very helpful to an industrial engineer, specially in textile industry to raise productivity. Probability concepts are used to determine these effects through theoretical solutions. This paper contains a general discussion on the subject of machine interference. A few theoretical solutions are discussed and the application of the methods of Ashcroft and Benson and Cox are illustrated in a study undertaken in the weaving process of a textile mill.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING DIVISION

Synthesis of A.C. Lag Networks Using R. C. and Active Elements

J. G. Advani
Non-member

and

R. P. Jain
Non-member

In this paper, a general transfer function for A.C. lag networks is derived for the D.C. lag network transfer function by the use of low-pass to band-pass transformation and it is observed that it is not always possible to synthesize this transfer function with R. C. elements only. To avoid the use of inductances, active elements in form of negative impedance convertor one used for the synthesis of A.C. lag networks. Kidariwala's method of synthesizing non-R.C. impedance functons by R and C elements along with one negative impedance convertor can be utilized for synthesizing A.C. lag networks. A typical voltage transfer function for A.C. lag networks is synthesized for the following three cases : (i) As an open circuit voltage ratio of a four-terminal network ; (ii) As the transfer function of a four-terminal network trrmi ated in 1 ohm resistance ; and (iii) As the transfer function of a four-terminal network terminated in 1 H inductance. It it observed that only one negative impedance convertor it required in each network obtained for the above three cases, that the networks realized are reciprocal across the input and output terminals and that the networks are either unbalanced or three-terminal networks.

Phase Utilization Characteristics of R.C. Equalizers in Servomechanism

H. Banerjee
Non-member

In this paper, the attenuation and phase frequency characteristics of different types of R.C. networks are discussed. The correlation between the topology of the networks and their response characteristics is brought out. An analytical method of design of lead and lag network using the phase-frequency characteristic only is advanced and a numerical example of design is given.

The Use of Standard Tables for Computing Attenuation-Phase Plots of Linear Systems

Dr. S. Das Gupta
Associate Member

In this paper, an attempt is made to develop general equations for the transfer function elements which play an important role in the analysis of control systems. A

method for easy representation of some of the elements involved it given and an overall A-Ψ plot is derived. A set of mathematical tables are also given to greatly simplify the point-by-point calculation of the A-Ψ plot.

The Direct Method of Liapunov

R. H. Engelmann

Non-member

A review is first presented of the basic concepts of Liapunov's direct method of determining stability of differential equations, followed by presentation of three methods of constructing Liapunov functions. Examples are given to illustrate the utility and limitations of the method.

Root-locus Break-in and Break-away Points

M. M. Gupta

Non-member

In this paper, the mathematical relationship in feed back control systems are given. Methods for the determination of root-locus break in and break away points for control systems having unity feed back are also adalyzed.

Current Controlled Bridge Oscillator

Prof. T. S. K. V. Iyer

Non-member

and

V. Prasad

Non-member

An R.C. oscillator can be evolved using the transistor as a controlled current source. The harmonics can be reduced by giving frequency independent current feed back in a bridge configuration. It is then similar to the Wien bridge oscillator but is in the current mode. In this paper the possible improvement with the current bridge is studied and the results of an experimental transistor oscillator are given.

A Study of Backlash in Feed Back Control Systems

I. J. Nagrath

Non-member

and

D. C. Surana

Non-member

In this paper, a phase-plane technique for the solution of generalized backlash problem in a feed back control system with inertia, and viscous and coulomb frictions

on both tipes of backlash is prescribed. The general time solutions are given for determining the time required to take up backlash and for the case of backlash with no coulomb friction on either side, a numerical method based on phase-plane technique is advanced. By this method, an overall study of several cases involving inertia and viscous friction on both sides of backlash is carried out and general results obtained. In addition, the cases of an instrument servo with only coulomb friction and with both viscous and coulomb friction on motor side are analyzed. A simple method of investigating the existence, location and amplitude of limit cycles is presented.

Simulation of Fourth Order Systems with Triple Lead by a Single Operational Amplifier

L. K. Wadhwa
Non-member

and

Maj. S. P. Sharma
Associate Member

In this paper a network consisting of one operational amplifier, four capacitors and four resistors capable of simulating fourth order linear systems having a triple zero at the origin is presented. The design equations and the physical realizability conditions are also given.

INSTITUTION NOTICES

Refresher and Specialist Courses in Engineering, University of Roorkee, Roorkee

The University of Roorkee will hold Refresher and short-term Specialist Courses in engineering as detailed below.

A three-month refresher course in civil engineering will be held in two parts, from August 3 to November 2, 1964. Part 1 deals with buildings, foundation engineering, concrete technology ; and Part 2 with highway and bridges.

A three-month refresher course in mechanical engineering will be held from November 18, 1964 to February 17, 1965. Part 1 of the course covers production engineering—industrial engineering and workshop technology; and Part 2 covers power plant engineering—steam, Diesel and hydro plant.

A three-month refresher course on electrical engineering will be held from April 9 to July 8, 1964. Part 1 of the course covers transmission and sub-stations ; and Part 2 covers generation.

A three-month refresher course will be held from May 3 to July 12, 1965. Part 1 of the course covers irrigation and hydraulic engineering, sediment transport and hydrology, river training, and flood control; Part 2 covers soil mechanics and earth dams, rigid dams, spillways and power houses; and Part 3 covers drainage, ground water development, waterlogging and soil conservation.

A three-month course in public health engineering for engineering subordinates will be held from September 1 to November 30, 1964, and another course from December 1, 1964 to February 27, 1965.

These courses include tours to interesting sites.

The following specialist short-term courses will also be held during the period mentioned against each.

1.	Welding Technology	August 18 to September 7, 1964
2.	Electric Power Transmission	September 16 to October 30, 1964
3.	Thermal Power Generator	September 18 to October 12, 1964
4.	Earthquake Resistant Structural Design	
5.	Foundation Engineering	January 4 to February 12, 1965
6.	System Protection	January 22 to February 19, 1965
7.	Modern Electric Devices	May 10 to 31, 1965
8.	Heat Treatment of Metals	July 2 to 23, 1965
9.	Engineering Mathematics	January 1 to 30, 1965
10.	Design of Water Towers	July 6 to 31, 1965
11.	Mechanical Design of Transmission Lines and Towers	July 10 to 31, 1965

Further details of the courses can be obtained from the Director, Refresher Courses, University of Roorkee, Roorkee, U.P.

Working Group on Piles

A Working Group on Piles has been formed by the Central Building Research Institute to study a number of specific problems on piling. The Group feels it necessary to record the pile load test data in a standard form, somewhat on the lines similar to those suggested by the Joint Committee on Pile Foundations of the Institution of Civil Engineers, London. This would help proper interpretation of the data and ultimately rationalize the design of pile foundations. A suitable data sheet has been prepared and is available on request from Shri G. S. Jain, Secretary, Working Group on Piles, Central Building Research Institute, Roorkee, U.P.

FORTHCOMING CONFERENCES

Symposium on 'The Study of Soil Properties in the Calcutta Region', Calcutta, September 1964

A Symposium on 'The Study of Soil Properties in the Calcutta Region' will be held in Calcutta in September 1964. The symposium will be held under the auspices of the Bengal Centre of the Institution and the Central Building Research Institute, Roorkee. Members willing to participate in the symposium may contact the Honorary, The Institution of Engineers (India), Bengal Centre, 8 Gokhale Road, Calcutta 20, before July 1, 1964.

Symposium on 'Role of Architects, Builders and Engineers in Modern Engineering Construction', Ranchi, September 1964

A symposium on 'Role of Architects, Builders and Engineers in Modern Engineering Construction' and an exhibition on 'Architecture Today', will be held at Ranchi in September 1964. These will be organized by the Builders' Association of India. Papers for the symposium are expected to cover the following aspects :

1. The architectural concept and its realizàton in construction through structural design ;
2. The effect of latest invention and use of building materials in architecture and engineering construction ;
3. Economy in the combined concepts of architecture and engineering ; and
4. Any other view, relevent to the spirit and the perspective of this symposium

Intending contributors should send their manuscripts on or before July 15, 1964, to Shri S. R. Kar Roy, Honorary Secretary, Builders' Association of India, Ranchi Centre, P.O. Dhurwa, Ranchi.

Further details of the symposium and exhibition can be obtained from the Honorary Secretary, Builders' Association of India, Ranchi Centre, Lodma Road, P.O. Dhurwa, Ranchi, Bihar.

Symposium on 'Puzzolanas—their Survey, Manufacture and Utilization, Delhi, December 1964

The Central Road Research Institute, New Delhi, is planning to organize a 3-day symposium on 'Puzzolanas—their Survey, Manufacture and Utilization' at Delhi, in December 1964. It is hoped that the subject will be of sufficient interest to civil engineers, engineering geologists and industrialists connected with cement, lime or ceramic manufacture. The subjects of the symposium are : (i) Evolution of Cement Saving Material Like Puzzolana—Cement or Lime-Puzzolana Mixturet, (ii) Necessary Raw Material Survey, and (iii) Details of Manufacture. Papers based on the above topics are invited by the Institute.

Further details can be obtained from the Director, Central Road Research Institute, New Delhi 20.

The 1964 Session of the International Federation of Surveyors, Sofia, August 22-29, 1964

The 1964 Session of the International Federation of Surveyers will be held in Sofia, Bulgaria, from August 22-29, 1964. At the same time, the Section of Geodesy and Organization of Land Exploitation together with the General Administration of Geodesy Cartography in Bulgaria and the State Committee of Construction Engineering and Architecture will organize an international symposium on 'Surveying in Construction Engineering' and an exhibition of geodetic instruments and geodetic and cartographic articles. At the symposium, lectures will be delivered by specialists of many countries on surveying in construction engineering.

Registration forms may be obtained from NTS—Section of Geodesy, Rakovsky 108, Sofia, Bulgaria.

The Second Australasian Conference on Hydraulics and Fluid Mechanics, University of Auckland, New Zealand, December 6-12, 1965

The Second Australasian Conference on Hydraulics and Fluid Mechanics will be held at the University of Auckland, New Zealand, from December 6 to 12, 1965. Papers on all aspects of fluid mechanics, hydraulics and hydraulic engineering are invited by the Convenor of the Conference.

Further details can be obtained from Convenor, c/o The University of Auckland, School of Engineering, Ardmore College Post Office, Auckland, New Zealand.

BOOK ACKNOWLEDGMENTS

1. **Engineering and General Geology.** P. Singh. *Katson Publishing House*, Ludhiana. Rs. 13. 426 pages.

This book intended to serve as a text book, is specially designed to cover the needs of students in Indian Universities.

2. **Worked Examples in Electrical Engineering.** Vol. 1. Direct Current. P. V. Gupta and M. R. Aggarwal. *S. Chand & Co.*, Delhi. Rs. 7.50. 1960, 256 pages.

The book is intended for engineering students, who arleady have a sound knowledge of the basic principles in electrical engineering and require guidance in their application. A good variety of problems have been solved in full detail.

3. **Worked Examples in Electrical Engineering.** Vol. 2. Alternating Currents. P. V. Gupta and M. R. Agarwal. *S. Chand & Co.*, Delhi. Rs. 15. 1964, 532 pages.

This book is a companion volume to the Part 1 (Direct Current) published earlier. In this volume theory has been explained in sufficient detail and the authors have tried to make the book selfcontained and complete. A large variety of problems on alternating currents have been solved in full details and every effort has been made to make the solutions as easily understandable as possible. Each chapter is followed by a sufficient number of unsolved problems. Three chapters deal with the design of A.C. machines fully illustrated with solutions.

4. **Chemistry for Diploma Students.** 3rd editon. S. K. Saxena. *Kamlesh Prakashan*, Kanpur. Rs. 9. 1963, 300 pages.

This book has been written to serve as an introduction to chemistry and its application to different branches of engineering and is primarily meant for students preparing for first year of the National Certificate Course of the All India Council of Technical

Education and diploma courses in engineering of various boards of technical education in India. An attempt has been made to present the subject matter completely on engineering bias. Important principles have been illustrated by means of solved examples. Chapters on water, fuels, engineering metals and alloys are the specialities of this book. Large number of exercises selected from standard books and examination papers of various universities and boards have been added throughout the book as solved and unsolved exercises. This, third edition has been completely revised.

5. **A Text Book of Public Works Accounts** S. C. Dikshit and Jagdish Prasad. *Subodh and Company*, Lucknow. Rs. 10.50. 2nd edition. 1964, 334 pages.

This book is intended to serve as a text book in Public Works Accounts and a guide to engineers and overseers working in the government engineering departments. It deals with methods of maintaining important records and avoiding common mistakes and gives the rules and practices followed in the Central Public Works Departments. In this edition, the book has been thoroughly revised. New revenue and expenditure heads of account, as introduced from April 1, 1962, have been incorporated. Examples are now given in metric units. A new chapter on travelling allowance and an Appendix on book-keeping have been added.

6. **Photo-electric Devices in Theory and Practice.** H. Carter and M. Donker. *Philips Technical Library*. Rs. 20. 1963, 130 pages.

Photo-electric devices are playing an increasingly important part in modern industry and it is vitally necessary that both engineers and technicians in both the mechanical and electronic engineering fields should have a sound grasp of their principles and practical applications. This book fills a gap in current literature by relating the principles to practical industrial applications in a manner which will be of value both to engineers and technicians. This first part of the book outlines the theoretical principles in a simple style, whilst the second part describes in detail over thirty photo-electric devices used in industry with numerous illustrations and much technical detail. This book is intended for all engineers and technicians seeking to relate the academic theory of photo-electric to practical industrial applications whilst many senior students will find it a valuable instruction to a fascinating and increasingly important branch of electronics.

7. **Mathematical Theory of X-Ray Powder Diffractometry.** A. J. C. Wilson. *Philips Technical Library*. Rs. 24. 1963, 128 pages.

A modern powder diffractometer is capable of great accuracy in the measurement of both line positions and line profiles. In order to obtain the best results, however it it necessary to have a sound understanding of the effect of the finite size of slits and other geometrical apertures limiting the X-ray beams. The detailed effect of these geometrical factors on the line centroids and mean-square breadths is given, with the corresponding results for peak positions and integral breadths wherever possible. The inevitable limitations set by the nature of X-radiation and its interaction with matter are treated and an interpretation of the effectts of crystal imperfections is given.

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from Bulletin for October 1963)

STUDENTS

No.	Name	No.	Name
41100	Dhulabhai Lallubhai Patel	41143	Om Prakash Sharma
41101	Ramesh Chandra Agarwal	41144	Anant Subray Shinganmakki
41102	Saumyendra Kumar Pal	41145	Satyanarayana Setty
41103	Anup Kumar Bandyopadhyay	41146	Joy Deb Basak
41104	Sureshchandra Vadilal Shah	41147	Asit Kumar Chatterji
41105	Sharad Krishnaji Khadye	41148	Sudhindra Mohan Sarkar
41106	Sudhir Ranjan Bose	41149	Yagvir Singh
41107	V. V. Subramanya Lakshmi Jagatpati Rao	41150	Sohan Lal Kalia
41108	Anil Chandra Das	41151	Hazoor Dass
41109	Ramesh Chandra Narula	41152	Harish Chandra Sharma
41110	Chandrakant Ramchandra Shah	41153	Balram Das Agarwal
41111	Kumar Sushil Kumar Murlidhar	41154	Jyotirmay Ghosh
41112	Radha Krishna Chand	41155	Radha Nath Mukherjee
41113	Ramdas Manikchand Kochar	41156	Prithwish Chandra Biswas
41114	Malkiat Singh	41157	Durga Das Kundu
41115	Onkar Nath Jijja	41158	Ramesh Chandra Disawal
41116	Sideshwar Prasad	41159	Subhash Totaram Chaudhari
41117	Harnam Singh Sachdeva	41160	Jnanesh Chandra Roy
41118	Satgur Kumar Mehta	41161	S. S. Sangha
41119	Israni Gope	41162	Kruttibasa Swayin
41120	Krishna Gopal Choudhury	41163	Ashok Kumar Maniktala
41121	Nitin Bhagwatishanker Shukla	41164	Dipak Kumar Chanda
41122	Biswanath Das	41165	Nawabali Mirzawali Himmati
41123	Indranath Mandal	41166	Prakash Jethanand Wadhwani
41124	Brijesh Kumar Shrivastava	41168	Hari Mohan Srivastava
41125	Yogeshchandra Shantilal Contractor	41169	Rishindranath Rath
41126	Prabir Kumar Sen	41170	Pushpakar Shankar Khandekar
41127	Shyam Bheroomal Seernani	41171	Mrinal Kanti Bose
41128	Anand	41172	Prasanta Kumar Das
41129	Shib Narayan Bose	41173	Dhirendra Singh Kushwaha
41130	Kapal Dev Sethi	41174	Ipuru Venkataraman Govindarajan
41131	Munjuluri Sreeramamurty	41175	Narendra Bhushan Srivastava
41132	Prem Swaroop Malhotra	41176	Radha Krishan Juneja
41133	Shivaji Upadhyay	41177	Ranjit Majumdar
41134	Baij Nath Sharma	41178	Ram Bhushan
41135	Yashwant Singh Chauhan	41179	Ram Rajwani
41136	K. N. Bhagavan	41180	Sarit Kumar Das Pattanayak
41137	T. V. Ramanan	41181	D. Balachandra
41138	Jagdish Lal Kesari	41182	Prem Chandra Srivastava
41139	Naim Ullah Khan	41183	Tippur Narayanarao Srinath
41140	Bimal Kumar Bhasin	41184	Mahipal Singh Soam
41141	P. N. Anantapadmanabhan	41185	Uma Kant Agarwal
41142	Thottan Porinchu Johnny	41186	Prem Narain Khare

STUDENTS (*contd.*)

No.	Name
41187	P. Mathew John
41188	Prasanta Kumar Mookherjee
41189	Asoke Kumar Das
41190	Samarendra Prasad Sen
41191	Sanat Kumar Sen
41192	Prasantakumar Dutta
41193	Narugopal Manik
41194	Kasinath De
41195	Uma Singh Bhadoria
41196	Ghasiram Bhoi
41197	Vijai Kumar Gupta
41198	Naraindas Jethanand Bhatia
41199	Mohammad Haroon
41200	Shambhoo Nath Kapoor
41201	Gubbala Veeravenkata Raja Rao
41202	Jagdish Chander Nangih
41203	Karuthedath Cheriya Narayanan Namboodiri
41204	Subodh Kumar Baksi
41205	Tarkeshwar Sharan
41206	Virendra Singh Sajwan
41207	Jagdish Chander
41208	Jagdish Prasad
41209	Manojkumar Basu
41210	Tara Shankar Biswas
41211	Avtar Singh Sandhu
41212	Satiranjan Goswami
41213	Kalyan Kumar Chattapadhyay
41214	Shailendra Kishore Varma
41215	Yogendra Pratap Jaiswal
41216	Satyendranath Bandyopadhyay
41217	Kailash Pati Sharma
41218	Jatindra Nath Patnaik
41219	Vadilal Tribhovandas Thakker
41220	Challapalli Seetaramasastry
41221	Kumuda Chandra Rauto
41222	Jagdish Chandra Gupta
41223	Pranshankar Khemchand Panchal
41224	Nalinkumar Benjamin Kapadia
41225	Haridas Kuttippurath
41226	Parimal Sarkar
41227	Vasu Dev
41228	Ananthaswamy Lakshmanarao Cavalay
41229	Bichitrananda Naik
41230	Sadashiv Shankar Oka
41231	Chakrapani Lakshman Rao
41232	Basudeb Chatterjee
41233	Robindra Nath Mallick
41234	Subrata Mitra
41235	Niroj Ranjan Pal
41236	Sunil Chandra Chakrabarti
41237	Nirod Adhikary
41238	Tapan Kumar Ganguly
41239	Stany Peter Pereira
41240	Edavana Panookaran Valsaraj
41241	Shyam Lal
41242	Satya Vir Singh
41243	Maganlal Naranbhai Patel
41244	Liladhar Damodardas Rathod
41245	Arabinda De
41246	Murali Mohan Patnaik
41247	Bhanuprasad Bhogilal Bhatt
41248	Katakota Kalicharana Patro
41249	Ved Prakash Kulshreshtha
41250	Avinash Chandra Narula
41251	Sudesh Chander Khurana
41252	Dilip Kumar Bhadury
41253	Suresh Madhavrao Padwal
41254	Cherala Sankunny
41255	Om Prakash Kumar
41256	Minanath Kanoba Kshirsagar
41257	Krishnaji Jiwaji Kulkarni
41258	Jayantibhai Karsanbhai Patel
41259	Joginder Singh Bedi
41260	Vasudev Raj Joshi
41261	Ajitkumar Manilal Shah
41262	Suchan Chandra Tamuly
41263	Hare Krishna Majumdar
41264	Dilip Kumar Sen Gupta
41265	Braja Kishor Khamaru
41266	Pran Gobinda Basak
41267	Amit Kumar Das Gupta
41268	Bimal Kumar Chaudhuri
41269	Arup Ronjon Roy
41270	C. D. Varghese
41271	Jagdishchandra Manilal Soni
41272	Roshan Lal
41273	Brahm Dutt Bhargava
41274	Hans Kumar
41275	Chandrakant Narayan Rajguru

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No.	Name
41276	S. Ayyappan Chettiar
41277	Madhukar Kashinath Gokhale
41278	Bipin Shankerprasad Boch
41279	Subramaniam Gopalan
41280	C. Padmanabha Pillai
41281	Manik Ranjan Mukhopadhyay
41282	Manohar Deepchand Punjabi
41283	Prabhakar Sakharam Shahane
41284	Dinabandhu Bandyopadhyay
41285	Asokranjan Guha
41286	Kishin Khubchand Jagtiani
41287	Sunil Kumar De
41288	Gope Hariram Hargunani
41289	Peralath Panayanthatta Kumaran Nair
41290	Baikunth Nath
41291	Ajit Sudhakar Manolkar
41292	Chandra Kishore Dikshit
41293	Daivendar Kumar Sud
41294	P. Ramesh Rao
41295	Vinayak Narayan Sakhardande
41296	Ramrao Keshavrao Khamkar
41297	Sankariprasad Sarkar
41298	Ramikant Hemchand Modi
41299	Sharad Kasinath Raote
41300	Ram Hare Shrivastava
41301	Gopalapillai Sasisekharan Nair
41302	Faredun Erach Mirza
41303	Paladugu Radhapathy Naidu
41304	Suresh Pandurang Jadhav
41305	Vijay Kumar Chawla
41306	Brij Mohan Thapa
41307	Udaysinh Gemalsinh Mangrola
41308	Noormohmed Babamiya Gondekar
41309	Ramchandra Madanlal Chaudhari
41310	Sudhamay Bhattacharyya
41311	Virendra Prasad Srivastava
41312	K. Abdul Hakeem
41313	Babu Ram Varshney
41314	Jawahar Lal Matu
41315	Bala Datt Joshi
41316	Thomas Rebello
41317	Gulam Hazrat Khan
41318	Ram Kumar Sharma
41319	Man Singh Sagar
41320	Nirmal Singh
41321	Thakorlal Govindbhai Rami
41322	Hemendra Kumar Shankerlal Pathak
41323	Jaydev Ramprasad Desai
41324	Jai Bhagwan Maheshwari
41325	Shri Narayan Mishra
41326	Manohar Lal Narang
41327	Agaram Balajirao Prahlad
41328	Pravinchandra Chimanlal Shah
41329	Ananthakrishnapuram Srinivasan Ramaswamy
41330	Sham Lal
41331	Gurbachan Singh
41332	Rishi Kumar Govil
41333	Kuderegundi Subbaiah Rangaswamy
41334	Sanjib Kumar Barat
41335	Kunwar Singh Karki
41336	Ghulam Rasool Seddiqui
41337	Kanwal Kumar
41338	Basu Deo Ojha
41339	Seshan Hariharan
41340	Pradeep Anirudha Dave
41341	Chandrakant Indulal Gandhi
41342	Bangalore Inamti Sudheendranath
41343	Satya Prakash Garg
41344	Shriniwas Ramchandra Agrawa
41345	Girdhari Lal
41346	Krishan Kumar Mitta
41347	Girraj Singh
41348	Sushil Kumar Dhawan
41349	Sachdanand Kapilashrami
41350	Bangalore Chappalli Ananthapadmanabha
41351	Ramendra Roy Chowdhuri
41352	Ram Ratan Joshi
41353	Harish Chander Gulati
41354	Inder Kumar
41355	P. K. Kerala Varma Raja
41356	Chandreshwar Dayal
41357	Raghuvir Chand Bhavnani
41358	Jayavant Shantilal Parajia
41359	Gopilal Sangavi
41360	Sankaraiyer Parameswara Iyer
41361	Vijayappan K. Mathews
41362	Virupax Laxmanrao Kulkarni
41363	Bhuvnesh Bhanu Trivedi
41364	A. Ramakrishna

STUDENTS (*contd.*)

No.	Name
41365	Muzaffarul Haque Ansari
41366	Ram Nayan Singh
41367	Mohinder Kumar
41368	Vimalesh Chandra Agarwal
41369	Shyam Sunder Bhargava
41370	Devendra Bhagawantrao Kulkarni
41371	Tapan Kumar Roy
41372	Balkunje Premananda Shenoy
41373	Umiashanker Ambaram Pandya
41374	Rajat Kumar Mitra
41375	S. Rama Iyer
41376	Ayodhya Prasad
41377	Sundar Singh Kshatriya
41378	Rajinder Nath
41379	Omkar Nath Kaul
41380	Ramakrishna Purushottam Dhople
41381	Kalampadan Paily Joseph
41382	Desh Kumar
41383	D. Joy Chakraverty
41384	Thimmaiah Narayana
41385	Hiralal Laxmidas Patel
41386	Purushottam
41387	T. Indranathan
41388	P. Joshua Mathew
41389	Dinesh Chandra Saxena
41390	Thakorbhai Motiram Patel
41391	Mohendra Maganlal Vyas
41392	Yash Kumar Bindra
41393	Nurulhasan Mohammedabbas Newrekar
41394	Pramod Anandrao Jayakar
41395	Belle Deva Rao
41396	Prem Narain Ahuja
41397	Fazalurrehman Karimbhai Contractor
41398	Vishwanath Yadaw
41399	Inderjitsingh Kartarsingh Kundra
41400	Bansi Dhar Pherwani
41401	Santokh Singh Rangi
41402	Ramesh Vasantrao Barhate
41403	Har Dat Singh
41404	A. A. Manikyaraja
41405	Suresh Waman Chandorkar
41406	Mukundrai Umashanker Joshi
41407	Manoranjan Dutta
41408	A. Vishnu Bhat
41409	Chandrika Prasad Verma
41410	Ramesh Govind Walimbe
41411	Namdev Gyanobarao Sarwade
41412	Hari Krishan
41413	R. Ananthasankara Iyer
41414	Jagjit Singh Kaila
41415	Asim Kumar Dutta
41416	Krishnamohan Chataraj
41417	Asitaranjan Guhathakurta
41418	Ajit Kumar Ray
41419	Debabrata Banerjee
41420	Nitai Charan Dhara
41421	Kumar Kanti Som
41422	Narendrakumar Govindlal Patel
41423	Deb Kumar Bhattacharya
41424	V. S. Sivarama Iyer
41425	Vishnu Kumar Sharma
41426	S. Selva Raj
41427	Arjunlal Chandulal Arora
41428	Sukhbir Pal Singh Bedi
41429	Ramesh Chandra Bhagat
41430	Krishan Kumar Sondhi
41431	Pramod Kumar Nashine
41432	Chandrakant Hiralal Shah
41433	Bishan Chandra Agarwal
41434	Harikrishna Maganbhai Patel
41435	S. H. Krishnappa
41436	Dinni Narsanna
41437	G. S. Raja Gopalan
41438	Sankedevanakoppa Rudrappa Vinayaka
41439	Harbans Lal Bhatia
41440	Kanaya Lal Pardasney
41441	Navinchandra Gokaldas Shah
41442	Kalyanbhai Popatbhai Borad
41443	Suresh Narayan Dubey
41444	Mohan Hiranand Valecha
41445	Varghese Chacko
41446	Yoganand Tikariha
41447	Ramesh Chandra Srivastava
41448	Kamlesh Kumar Saxena
41449	Ganti Nageswara Rao
41450	Subramanya Jayaraman
41451	Krishna Niranjan Prasad
41452	Nalini Kumar Bera
41453	Sourendra Nath Sanyal
41454	Asim Kumar Chattopadhyay

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No.	Name
41455	Dipak Ranjan Das
41456	N. A. Narayanan
41457	Amit Kumar Mukhopadhyay
41458	Subir Guha
41459	Debabrata Kantilal
41460	Tilok Chandra Dutta
41461	Shashikant Ramchandra Deshpande
41462	Sharda Sharan Choubey
41463	Basavaraj Maharudrappa Urolagin
41464	Mriganka Kumar Mitra
41465	Amit Kumar Chakravorti
41466	Dipak Kumar Banerjee
41467	Mihir Kumar Mukhopadhyay
41468	Gouri Sankar Bhattacharjee
41469	Asok Kumar Biswas
41470	Syamala Seshareddy
41471	Dilip Kumar Biswas
41472	Ranendra Nath Kundu
41473	Dilip Kumar Sarkar
41474	B. Venkateshiah Gopala Krishnaiah
41475	Kalidas Chattopadhyay
41476	Abdul Azeez Abdul Kareem Hubilikar
41477	Robindranath Choudhury
41478	Permanand Singh
41479	Abdus Subhan
41480	Asim Kumar Ray
41481	Swapan Kumar Roy
41482	Sadhanchandra Mazumdar
41483	Shyam Pahlajrai Bhatia
41484	Prem Prakash
41485	Kavalil Thomas George
41486	Aswathanarayana Gupta
41487	V. Kasi
41488	Ashok Kumar Laxmanrao Dighe
41489	Swaran Jit Singh Mann
41490	Madhav Vishnu Jog
41491	Kanwal Nain Singh
41492	Dulala Suryanarayana Naidu
41493	Dharm Singh
41494	Yatendra Singh Rathore
41495	Rajinder Kumar Gupta
41496	Niranjan Lal
41497	Kolala Nanjundaiah Veeranna
41498	Ramakant Mitrasen Agrawal
41499	Sudhakar Shantaram Nagarkar
41500	Damodaran Sathiadasan
41501	Sushil Kumar Srivastava
41502	Tandra Venkataramana
41503	Thammimangalat Govinda Variar
41504	Mohan Gajanan Bal
41505	Narasimhaiah Narayana Swamy
41506	Damoder Prasad Garg
41507	Gurusamy Sakthivel
41508	Krishnakant Vyas
41509	Laxman Gopal Pathak
41510	Pranab Kumar Sarkar
41511	Arun Kumar Guha
41512	Harinarayana Nayak
41513	Krishnadas Roy
41514	Samrindrachandra Chakraborti
41515	Ardhendu Bikas Kar
41516	Nitai Das Mondal
41517	Dipak Kumar Mondal
41518	Nepal Chandra Bhowmick
41519	Tumkur Gundappa Narasimha Murthy
41520	Vasantilal Champalal Chitode
41521	Upendra Bhalchandra Palsanekar
41522	Jagdish Chandra
41523	Mahboob Ali
41524	Jaspal Singh Luthra
41525	Parameswarampillai Krishnankutty
41526	M. P. Gopinathan Pillai
41527	L. S. Jagadeswaran
41528	Mohommed Iqbal Hussain Miyan Shaikh
41529	Dhanesh Chander
41530	Ram Prakash
41531	Srichand Rupchand Badlani
41532	Namdeo Janji Waghulade
41533	Rishi Kumar Kaushik
41534	Shiv Charan
41535	Munipalli Subramiah Ramanathan
41536	Ramesh Vasantrao Pathare
41537	Pramod Ahuja
41538	Sharad Ganesh Kane
41539	Jeppoo Laxminarayana
41540	Velluvakkandy Nandanan
41541	Milan Kumar Sarkar
41542	Pradip Kumar Datta
41543	Subhas Chandra Basu
41544	Arvind Narayan Dhamdhere

STUDENTS (*contd.*)

No.	Name
41545	Vijay Kumar Gupta
41546	Murdeshwar Lakshman Rao
41547	K. Vamanaprabhu Govinda Prabhu
41548	Kailash Chand Sabharwal
41549	Saiyed Jafar Abbas Safvi
41550	Madhavarao Raghavendra Rao
41551	Bolur Satischandra
41552	Annesh Balwant Kulkarni
41553	Krishna Mohan Bhatnagar
41554	Samir Kumar Ghosh
41555	Suraj Kumar Bhagat
41556	Basu Deb Pal
41557	Gautam Ojha
41558	Saradindu Prasad Dhar Chaudhury
41559	Satyabrat Misra
41560	Pandurang Damodhar Borole
41561	Bachan Lal
41562	Ratanlal Rupchand Sanklecha
41563	Suresh Krishna Deshpande
41564	Kumaran Sivaprasad
41565	Awtar Singh
41566	Dayal Detaram Vasandani
41567	Padam Chand Jain
41568	Kugulur Viswanathaswamy
41569	Osmond Anthony Fernandes
41570	Shyam Behari Khare
41571	Ashok Mahadeo Khaladkar
41572	Shantilal Shreechand Khabia
41573	Adhibhatla China Venkateswara Chainulu
41574	T. Sivaraman
41575	Chandgi Ram
41576	Naresh Chand Sharma
41577	Gopalan Sampath Kumar
41578	Parsi Nasarwanji Daruwala
41579	Mohan Singh
41580	Abdul Rafique Abdul Aziz Chowdhary
41581	Har Sharan Sharma
41582	Notar Krishan Nanda
41583	Tiruvisanallur Subramania Srinivasan
41584	Vayamkara Ramachandran
41585	Bharat Bhushan
41586	Vithal Yama Warke
41587	C. N. Gopala Krishna Pillai
41588	Shashikumar Anant Natekar
41589	Mahendra Kumar Gupta
41590	Prabhatsinh Umraji Jadeja
41591	Manoj Kumar Barua
41592	B. Vidyadhara Hegde
41593	Krishnamurthy Narayanan
41594	Narinder Kumar Verma
41595	Bhagwat Sharan Mool Chand Nayak
41596	Huseni Kayamali Lokhandwala
41597	Sadanand Purushottam Kulkarni
41598	Sudhir Chandra Acharyya
41599	Sudhir Madhukar Karnik
41600	Arun Madhukar Gupte
41601	Ravinder Kumar Puri
41602	Satish Kumar
41603	Uchit Lall Tanti
41604	Subhas Kumar Basu
41605	Arun Kumar Mukhopadhyay
41606	K. Sudhindra
41607	Hemendra Popatlal Shah
41608	Zamir Ahmed
41609	Narendra Kanyalal Santaney
41610	Mahendrakumar Shantilal Shah
41611	Gajanan Ramchandra Patankar
41612	Arthur Lewis
41613	Lalit Kumar Dube
41614	Parakkunnath Shankaranarayanan
41615	Chand Mal Koria
41616	Tikamchand Phool Chand Gangwal
41617	Shyam Sunder
41618	K. L. Sripathy Rao
41619	Krishna Kishore Jeidka
41620	Narella China Bala Kesava Rao Gupta
41621	Mahanth Rai
41622	Amar Nath Rajput
41623	Sanagavarapu Krishnamurty
41624	Polavarapu Venkateswara Rao
41625	Priyabandhu Choudhury
41626	Nirmal Kumar Pal
41627	Biswanath Majumdar
41628	Narayanaswamy Dhanasekaran
41629	V. Idicula
41630	Tilak Raj Gandhi
41631	Umesh Wagle
41632	Santipada Bhattacharyya
41633	Avinash Dinkar Karyekar
41634	Ittithara Kovilaparambil Krishnan

STUDENTS (*contd.*)

No.	Name
41635	Sankaranarayanan Bhaskaran Nair
41636	P. A. Narayanan
41637	Avinash Dhondopant Luktuke
41638	J. Jagadesan
41639	Nelmane Seshaiyer Anantharaman
41640	Hemantkumar Purushottam Dev
41641	Munireddyapalyam Ramaiah Chandrashekar
41642	Manoj Mohan Das Gupta
41643	Banamali Gupta
41644	Sadashiv Dalshing Solanki
41645	Dharmendar Kumar Bhatnagar
41646	Bhulan Ram
41647	V. Loganathan
41648	Jatinder Kumar Mehta
41649	V. K. Narayana Kaimal
41650	Manohar Lal Garg
41651	Jitendra Kumar
41652	Didar Singh
41653	C. S. Madhava Kurup
41654	Ranjan Chattopadhyay
41655	Prabir Kumar Chattopadhyay
41656	Uma Shanker Bahl
41657	Ashit Bipin Jhaveri
41658	Raghbir Singh Kalra
41659	Vinay Kumar
41660	Sharda Prasad Misra
41661	Ahmed Abdul Aleem
41662	Ram Lal
41663	Satyam Kundula
41664	Shrinivas Terdalkar
41665	C. K. Unni Krishnan Nair
41666	Khagendra Nath Jui
41667	Agiakar Singh
41668	Dilip Kumar Adhikari
41669	Dhrubanath Sen
41670	Balbir Singh
41671	Diwan Chand Mahajan
41672	Vadlamudi Deenapathi
41673	Surendra Mohan Talwar
41674	Ram Kumar Dubey
41675	Om Parkash Sapra
41676	Divakar Rangnath Kulkarni
41677	Raj Bir Singh
41678	Shatrughan Kasturia
41679	Raj Kumar Batra
41680	Jugal Kishore Sama
41681	Kishori Lal
41682	Om Prakash Kapoor
41683	Kartar Singh Baweja
41684	Vijay Yadavrao Salunke
41685	Kanayo Sadharmal Israni
41686	Raj Narain Singh
41687	Deb Prasad Das Gupta
41688	Hasmukh Gordhandas Gandhi
41689	Jitendra Kumar
41690	Pammani Parshotam
41691	Yoginder Sain Bahl
41692	Hari Kumar Gupta
41693	Brij Mohan Lal Sharma
41694	Jagdish Gupta
41695	Prakash Chandra
41696	Shambhoo Nath
41697	Narinder Sain Bahl
41698	Kastori Lal
41699	Jahar Singh Verma
41700	Bal Krishan Palta
41701	Mukulmay Bandyopadhyay
41702	Sharad Vishnu Dixit
41703	Kalyan Das
41704	Jagdish Singh Chauhan
41705	Gopal Krishan Walia
41706	Codur Andinarayana Sripathy
41707	Kasibhatla Krishna Murty
41708	Prem Chandra Gupta
41709	Kulbir Singh Bhogal
41710	Syed Abdul Baseer
41711	Varughese P. Varughese
41712	P. Sudhakara Shetty
41713	Kulbir Singh Wohra
41714	Sita Ram
41715	Chandrashekhar Dattaram Kamat
41716	Avinashi Nath Bhargava
41717	Banarsi Dass Sharma
41718	Shrikant Y. Pradhan
41719	Mohammed Hussain
41720	Mangudi Sivanandham Vaidyanathan
41721	Arun Ramchandra Godbole
41722	Gurdhian Singh
41723	Vishnu Kumar Kulshrestha

STUDENTS (*contd.*)

No.	Name
41724	Thomas George
41725	Lok Chand Khatri
41726	Manojit Banerjee
41727	Shreerang Ganesh Bapat
41728	Rajendra Prasad Gupta
41729	Gurcharanjit Singh Sihota
41730	Amrik Singh Sehra
41731	Yeshwant Govindrao Thatte
41732	Kailash Nath Sharma
41733	Jagdish Chander
41734	Rajinder Pal
41735	Jagannathan Rajaraman
41736	Kewal Krishna Bansal
41737	M. Narayana Bhat
41738	Satya Paul Vermani
41739	Vishnu Datta Tyagi
41740	Popuri Rama Rao
41741	Dinesh Vyankatesh Kamat
41742	Nand Lal Paryani
41743	K. G. Raghavendra Rao
41744	Kanailal Chattopadhyaya
41745	Raj Kumar Kamboj
41746	Amar Singh Gill
41747	Som Parkash Juneja
41748	Amarjit Singh
41749	Khushal Singh
41750	Shivaji Bhivasan Patil
41751	Varadaraya Kumbala Nayak
41752	Rameshchandra Chandrabhan Kapur
41753	Charanji Lal Gupta
41754	Atma Singh Sabar
41755	Ram Dev Gupta
41756	Rajangam Gopal
41757	Bal Raj
41758	Shrikrishna Shivram Joshi
41759	Chandrashekar Vinayak Ghodke
41760	Ragunath Malhotra
41761	Deonath Garudik
41762	Chelakkara Venkitaraman Subramanian
41763	Gutta Balakrishna
41764	Rajmangal Vishwakarma
41765	Avtar Singh
41766	Bhagwan Das
41767	Balkrishna Vithal Dike
41768	Ajeet Bhan

No.	Name
41769	Devi Prashad
41770	Ramesh Kumar Kacker
41771	Ram Prakash Sinha
41772	Somes Chandra Saha
41773	Kadali Venkataratna Rao
41774	Daulat Ram Sahu
41775	Ramesh Chandra Chaturvedi
41776	Satya Prakash Srivastava
41777	Chandan Kumar Mukhopadhyay
41778	Durgesh Kumar Saxena
41779	Arvind Ramchandra Patwardhan
41780	Ramesh Kumar Dewan
41781	Onkar Prasad Nema
41782	Navin Kumar Govil
41783	Rameshchandra Madholal Khosla
41784	Arjan Dev Sehgal
41785	Iqbal Singh Saini
41786	Man Mohan Pury
41787	Krishnaiyer Krishna Iyer
41788	Raj Kumar Chawla
41789	Bal Krishna Sharma
41790	Manohar Phadke
41791	K. Radhakrishnan
41792	Bhagwan Dass Bhutani
41793	Kultar Singh Sawhney
41794	Rajinder Parshad
41795	Vijaya Prakash Joshi
41796	Manoharlal Hashmatrai Jhurani
41797	Ravindra Pal Singh Sengar
41798	Kasturi Lal Kathpal
41799	Trilok Chand Joshi
41800	Gurdev Singh
41801	Omkar Nath
41802	Uttamjit Singh
41803	Sharad Shankar Patil
41804	Narinder Kumar Puri
41805	Naresh Chandra Sharma
41806	Naveen Chandra Bhargava
41807	Umesh Chandra Vidyarthi
41808	Kultaran Singh Anand
41809	Tridib Kumar Sarkar
41810	Prem Dhar Lal Srivastva
41811	K. Raghavan Pillai
41812	Nathu Ram Garg
41813	Tir Bahadur Jha

STUDENTS (*contd.*)

No.	Name
41814	Sudhir Sadashiv Abhyankar
41815	Prabhakar Laxman Joshi
41816	Ram Dhan Thakral
41817	Parshotam Lal Meini
41818	Shree Niwas Muchhal
41819	Bhawat Prasad
41820	Nand Kishore
41821	Rajeshwar Balh
41822	G. Ramachandran
41823	Vijay Kumar Bhalla
41824	Hans Raj
41825	Ram Krishan Shukla
41826	Ramesh Gobindram Lalchandani
41827	Prabhu Dayal Tayal
41828	Bansi Lal Chawla
41829	Mohinder Singh Kari
41830	Thilla Radhakrishnan Ramakrishnan
41831	Om Parkash Nanda
41832	Krishna Vishnupant Tapikar
41833	Murari Lal
41834	Vishnu Purushottam Date
41835	Nakula Seetaramamurti
41836	Satya Pal
41837	Tummala Venkata Subba Rao
41838	Surendra Prakash Mathur
41839	Subhas Chandra Sahni
41840	Gyanesh Prasad Rai
41841	Mukand Lal
41842	Kunjukrishnapillai Kuttappan Nair
41843	Nanalal Jain
41844	P. M. Sankaranarayanan Nambudri
41845	Mohan Singh Gill
41846	Ajit Kumar Srivastava
41847	Kesarla Chinna Reddeppa Chetty
41848	Kuljit Singh
41849	Sudarshan Kumar Kakar
41850	Pritam Singh Guglani
41851	Ish Kumar Arya
41852	B. K. Narahari
41853	Ved Ram Gupta
41854	G. P. Radha Krishan Nair
41855	Ram Prakash Gupta
41856	Suhas Gangadhar Bhagwat
41857	Mahendrakumar Damodardas Shah
41858	Shashikant Ramchandra Sapre
41859	Pothukuchi Narayanamurty
41860	Amit Lal Sehgal
41861	Bota Mal
41862	Duli Chand Garg
41863	Ravindra Nath Bhatia
41864	Lakhmi Chand Gera
41865	Shiv Kumar Handa
41866	Araga Subba Krishna
41867	N. Natarajan
41868	Madhukar Haribhau Golar
41869	Santoshkumar Ghosh
41870	Vakada Surya Prasad
41871	Jatinder Parkash
41872	Inder Bhan Sharma
41873	Krishan Kumar Dham
41874	Nand Kisore
41875	G. A. Subbas
41876	Chuni Lal
41877	Kishan Chand Bhardwaj
41878	Challa Venkata Siva Rama Sastry
41879	Brijeshwar Prasad Bhargava
41880	Shiv Das Mathur
41881	Sahadeb Mandal
41882	Mohan Singh Dhillon
41883	Mikkilineni Umamaheswara Rao
41884	Govind Krishna Kulkarni
41885	Chunduri Venkateswarlu Gupta
41886	Ashok Kumar Sekhri
41887	Baldev Raj Gulati
41888	Sudhakar Vaman Dharwadkar
41889	Subhash Chander
41890	Prem Sagar Sharma
41891	Byomkes Ghosh
41892	Krishan Kumar Jettley
41893	Shrikant Yeshwant Ramani
41894	Hans Raj
41895	Brij Bhushan
41896	K. Sankara Pillai
41897	Nirbandhan Kumar
41898	Gulam Venkata Chalapathy
41899	Shiam Sunder Bansal
41900	Vinod Kumar Anand
41901	Gundumalla Mohana Rao
41902	Jagdish Lal Sikka
41903	Cpl. Arjan Nath Kaul

STUDENTS (*contd.*)

No.	Name	No.	Name
41904	Mohanlal Chandnani	41949	Cpl. Krishan Kant
41905	Jagdish Lal Chhabra	41950	Hiranmoy Bhattacharjee
41906	Kummamuru Lal Mohan	41951	Pamo Jethani
41907	Rajinder Kumar Bangia	41952	Kailash Chandra
41908	Mamuri Venkata Srinivasa Rao	41953	Vijay Kumar Mukhi
41909	Jatinder Pal Singh	41954	Yearm Veeresha
41910	Dharam Vir Sharma	41955	Ram Adhar Tiwari
41911	Santosh Kumar Chawla	41956	Prakash Narayan Saxena
41912	Harendra Kumar Kulshrestha	41957	Shrikant Laxman Sant
41913	Om Prakash Goel	41958	Brij Mohan
41914	Chitturi Purnananda Rao	41959	Patti Sreenivasulu
41915	Shailendra Nath Gupta	41960	Lakumu Komaraiah
41916	Ram Charan Singh	41961	Rajendra Paul
41917	Nand Kishore Malhan	41962	Arun Kumar Banerji
41918	Jag Dev Singh	41963	Ram Shankar Gupta
41919	Jagdish Chander Malik	41964	Ramchandra Ganpat Kudre
41920	Kakarlapudi Appala Sanyasi Raju	41965	T. K. Kunhikrishnan
41921	Sujit Kumar Paul	41966	Ram Nain Chaudhary
41922	Ennala Rammohan Das	41967	Doulat Karamchandani
41923	Syed Abdul Hafeez	41968	Chokati Narayanaswamy
41924	Chaman Lal Bajaj	41969	Gangaiah
41925	Ramesh Kumar Bhatnagar	41970	Sohan Singh Kulhan
41926	Tejinder Mohan Singh	41971	Kaushal Kishore Lal
41927	Shyam Prakash Singhania	41972	Indra Prakash Katyal
41928	Santosh Kumar Panday	41973	Pilli Veerannasetty
41929	Vishwa Nath Dubey	41974	Dattatray Nalharrao Kad
41930	Prem Sagar	41975	Garimella Subrahmanyam
41931	Mahesh Chandra Kheterpaul	41976	Kaipu Punna Reddy
41932	Sundar Lal Shaw	41977	Sukumar Bhattacharyya
41933	Lakhan Lal Verma	41978	Garikapati Narasimha Murty
41934	Bhim Sen	41979	Avvaru Subramanyam
41935	Rajendra Prasad Mahajan	41980	Vijjapu Kanaka Raju
41936	Kuldeep Singh Mann	41981	Sanagapaty Umamaheshwara Rao
41937	Ajit Singh Pandha	41982	Karra Kameswara Sarma
41938	Romesh Chander Bhatia	41983	Waman Ganesh Garge
41939	Hemendra Bhushan Brahmasthali	41984	Rameshwar Dass
41940	Avdhesh Chandra Sharma	41985	Vavilla Ramanathan
41941	Tirlochan Singh Lamba	41986	Ilavajhala Lalitha Sankara Sarma
41942	Srikrishna Chandra Piri	41987	Joginder Singh
41943	Jagdish Kumar	41988	Nallamalli Bal Reddy
41944	Chaman Lal Buth	41989	Shive Mohan Lal
41945	Govind Singh Rawat	41990	Kaushal Kishore Gupta
41946	Cheekala Suryanarayana	41991	Jagdish Chandra
41947	Bishan Dass Mendiratta	41992	Harbhajan Singh
41948	Dattatray Gopal Kashalkar	41993	Amrit Paul Chaba

STUDENTS (*contd.*)

No.	Name
41994	Cheruvu Anantha Rama Somayajulu
41995	Rajendra Prasad
41996	Yash Pal Singh Sharma
41997	Laxman Singh Verma
41998	Popat Babusa Pawar
41999	Joseph Paul Samuel
42000	Brij Mohan Bhatnagar
42001	Harish Chander Kohli
42002	Prabhakar Raghunath Patwardhan
42003	Manda Apparao
42004	Sat Pal
42005	Goggula Krishna Reddy
42006	Velpuri Narasimha Rao
42007	Mutunury Venkata Subbarayudu
42008	Vasant Mahadeo Patankar
42009	Mylapore Jayaram
42010	Tarajirao Sarjerao Jadhavrao
42011	Braj Nandan Singh
42012	Pragada Atchuta Ramalingaswamy
42013	Krishnaji Kedari Murkute
42014	Dinesh Chandra
42015	Pratap Narain
42016	Rayadurgam Venkobachar Seshagiri
42017	Arvind Chimanlal Shah
42018	Mirza Mansoor Baig
42019	Abbedoddi Vaddi Narayanappa
42020	Maddala Umamaheswara Rao
42021	Mohammed Hamid Ali
42022	Balaram
42023	Appasaheb Kallappa Kage
42024	Manohar Lal Julka
42025	Sudhindrachandra Datta
42026	Palala Laxmanarao Venkoba Rao
42027	Ram Tirath Malhan
42028	Shrikant Keshavrao Kulkarni
42029	Syed Ali Mian Zaidi
42030	Mandy Jayaram Balasubramaniam
42031	Madhav Prashuram Deval
42032	Vijay Ramchandra Lagu
42033	Vinayak Govind Patankar
42034	Digamber Yeshwant Gunjal
42035	Siraj Peer Mohammad
42036	Subhash Chandra Mittal
42037	Dinkr Ramchandra Bhure
42038	Baburao Dattatraya Sasane
42039	Dande Venkateswarlu
42040	Chelliboina Satyanarayana
42041	Ambadas Hemrajji Lanjewar
42042	Kashinath Dada Kolhe
42043	Brij Kishore Tiwari
42044	Bajarang Ganapati Mhetre
42045	Vasant Mahajoti Mane
42046	Prabhakar Panditrao Kulkarni
42047	Narindar Singh
42049	Konduri Venkata Prabhakara Rao
42050	Harihar Rao
42051	Ramesh Dattatraya Chandratre
42052	Biplab Kumar Kunda
42053	Syed Ismail
42054	Amal Kumar Basu
42055	Gobinda Chandra Kar
42056	Chaparala Dharama Rao
42057	Yeshwant Raghunath Mokashi
42058	M. Qamruddin
42059	P. S. Ramachandran Pillai
42060	Sunil Baran Chakrabarty
42061	Kunti Charan Agarwala
42062	Syed Yakoob Ali
42063	Shriram Ganesh Pendse
42064	Yeshavalal Punjalal Patel
42065	Chatur Partabrai Rupani
42066	Chelur Aswathanarayan
42067	Ashtekar Madhukar Ramchandra
42068	Pohal Singh
42069	Subodh Behari Lal
42070	Jagdish Chandra Kapoor
42071	Subodh Chandra Mukherjee
42072	Satya Prakash Sharma
42073	Debadas Bandyopadhyay
42074	Abulula Ahmedula
42075	Bikas Sengupta
42076	Mohammad Sirajuddin
42077	Venkat Ramulu
42078	Bidyut Halder
42079	Sukumar Chattopadhyay
42080	Arun Ramchandra Patil
42081	Mangesh Shankarrao Tavanandi
42082	Kajal Kumar Chakrabarti
42083	Suresh Vishwanath Sutaone
42084	Gopendra Kumar Nath

STUDENTS (*contd.*)

No.	Name
42085	Sumnjilal Hajarilal Barasinya
42086	Shyam Swarup Rastogi
42087	Sankaracharya Bhowmick
42088	Sachindra Kumar Chakraberti
42089	Pabitra Kumar Mukherjee
42090	Shyamal Kumar Sinha
42091	Baidyanath Bhattacharjee
42092	Dulal Krishna Das
42093	Omparkash Tejbhan Mehta
42094	Nirmalendu Sircar
42095	Sahasranama Subramanian
42096	Alok Nath Hajra
42097	Asit Kumar Choudhury
42098	Govindram Dhanrajmal Chhabria
42099	Nimai Chand Sen
42100	Tamal Kanti Banerjee
42101	Kalyan Kumar Sinha
42102	Kunatharaju Venkatrama Raju
42103	Uday Biswas
42104	Nabagopal Banerjee
42105	Radha Raman Nandy
42106	Debeshmohan Ghosh
42107	Santanu Bose
42108	Bimalendranath Choudhuri
42109	Kuppathil Unni Krishnan
42110	Subimal Ghosh
42111	Jiban Chandra Chaudhuri
42112	Pranballabh Dutta
42113	Narahari Vasudevulu Chetty
42114	Shyamal Kumar Ganguly
42115	Sunilchandra Kar
42116	Sajja Padmanabha Rao
42117	Sanjitkumar Das
42118	Thakur Dutt Sharma
42119	Arindra Nath Bhattacharyya
42120	Kalyan Kumar Dey
42121	Kondala Rao Gala
42122	Pannalal Banik
42123	Maheshchandra Airen
42124	Asit Kumar Mandal
42125	Kuttyachar Ganesan
42125	Karuna Sankar Ghosh
42127	Sudhakar Vasant Bhalerao
42128	Tadepalli Gangadhara Sastry
42129	Mohomed Moiziddin Hussain

No.	Name
42130	Nadella Sree Krishna Rajendra Prasad
42131	Pilla Kailasa Rao
42132	Jeyasinghraj Prabhakaran
42133	Umesh Dattatraya Pradhan
42134	Narayana Veeraraghavan Iyer
42135	Arun Mukund Pandit
42136	Pattam Mudiyam
42137	Chemmaseril Chacko Thomas
42138	Yashwant Dattatraya Dixit
42139	Sulalit Kumar Majumdar
42140	Dattatraya Ramakant Sawai
42141	Ramendra Nath Das
42142	Vijay Monohar Wagh
42143	Namdeo Shamrao Balwir
42144	Chanakath Bhaskaran
42145	Krishnamoorthy Prahlada Rao
42146	Prakash Kashinath Gadkari
42147	Dhurba Surya Subrahmanyam
42148	Chempanal Mathew Mathai
42149	Vasant Madhav Deshpande
42150	Arun Krishnaji Gapchup
42151	Arakalagud Ramaswamy Anantha Subba Rao
42152	Gopalapillai Jayachandran Nair
42153	K. G. Vargheese
42154	Yusufali Nazarali Bhojani
42155	Jagannadhaiyer Subramanian
42156	Ram Chander Rampalli
42157	Ashok Kumar Dewan
42158	Nazir Usman Khan
42159	Suresh Prabhakar Godbole
42160	Mahavir Rambhau Korade
42161	Kasukhela Venkata Nagaraja Sarma
42162	Shriniwas Rajaram Tophkhane
42163	Ashok Shamrao Gadge
42164	Shreekrushna Madhav Godbole
42165	Kurupet Venkatasetty Pandurangasetty
42166	Madan Mohan Ray
42167	Padigala Mahadevaiah
42168	Ratanlal Dewandas Jethwani
42169	Bhalchandra Amritrao Jambekar
42170	Harbhajan Singh Tarna
42171	Ajit Kumar Das
42171	Shyam Khildas Tajwani
42173	Mereian Leo Richard Tavera

STUDENTS (*contd.*)

No.	Name
42174	Prabhakar Hanmant Ahurkar
42175	Ashok Ramchandra Bhende
42176	Amar Singh
42177	Bhamidimarri Venkata Narasingarow
42178	Garikipati Suryabhagavanulu
42179	Dibyendu Chakrabarti
42180	Purnendubikas Ray
42181	Barunkumar Basu
42182	Ayloor Viswanathan Narasimhan
42183	Subrata Nath Chatterjee
42184	Sib Narayan Guha
42185	Vemuri Hari Narayan Sarma
42186	Rattan Singh
42187	Mohanraj Gopal Phadke
42188	Potaraju Sreehari Rao
42189	Sayyed Ahmed Vali Hajari
42190	Naranjan Singh
42191	Chandra Mohan Varma
42192	Ratnakar Dattatraya Ratnaparkhe
42193	Sikander Singh Gurm
42194	Raja Kashinath Agashe
42195	Om Prakash Kakar
42196	Arvind Kumar Sharma
42197	Ramesh Hari Karmarkar
42198	Rajendra Kumar Gupta
42199	S. Abdul Sattar
42200	Subramaniam Krishna Morthy
42201	Shrikant Dattatraya Ambardekar
42202	Coppicitty Krishna Rao
42203	Mallikarjun
42204	Mangalore Mohandass
42205	Nandiwada Sridhara Rao
42206	Rajendra Prasad Dobhal
42207	Shankar Bhimaji Agnihotri
42208	Vinayak Dattatraya Nerurkar
42209	Subrata Datta
42210	Asok Kumar Mukhopadhyay
42211	Allika Lakshman Rao
42212	Ganta Venkata Subbarao
42213	Durvasula Venkata Applanarasimham
42214	Vadapalli Gopalakrishnarao
42215	Radhavallabh Ramnath Dhoot
42216	Jagdish Parshad Gupta
42217	Javvadi Sambasivarao
42218	Satchidanand Purushottam Ogale
42219	Kishan Nangre
42220	Shamsundar Narayan Joshi
42221	Manmohan Kumar Verma
42222	Krishna Swarnkar
42223	Virendra Kumar
42224	Ajit Vishnu Jamnis
42225	Sarman Lal Jain
42226	Kishan Hasaram Matai
42227	Somesetty Shankaraiah
42228	B. Kesari Rao
42229	Dinkar Vinayak Shidhaye
42230	Kailash Chandra Agrawal
42231	Bal Bhadra Singh
42232	Suresh Chandra Misra
42233	Shashikant Vasudeo Gadre
42234	Dilip Subrao Divgi Sher Singh
42235	Thomas Daniel
42236	Kailash Chandra Joshi
42237	Paramjit Singh Chadha
42238	Samir Kumar Ray
42239	Chandrakant Hargovandas Shah
42240	T. L. Ramesh Kumar
42241	Ashokkumar Prakashdev Malhotra
42242	Saiyed Wahid Husain Naqvi
42243	Sher Singh
42244	Prabhakar Gurupadayya Hiremath
42245	S. Arunagiri
42246	Krishnakumar Pandurang Potdar
42247	Ashok Kumar Varman
42248	Gulshan Lal Sarna
42249	Hari Pada Chaudhuri
42250	Vadali Venkata Rao
42251	Mendu Ramarao
42252	Om Prakash
42253	Om Prakash Srivastava
42254	Vendra Chandra Rao
42255	Krishna Dutt Sharma
42256	Satnam Singh
42257	Gaddi Dhanunjai
42258	Kakumanu Rama Mohan Rao
42259	Turlapati Anjaneya Krishna Prasad
42260	Alampillymana Chandrasekharan Nambudiri
42261	Medasani Madhusudhana Rao
42262	Jampani Venkateswarlu

STUDENTS (*contd.*)

No.	Name
42263	Pokala Gnanaranjan
42264	Medarametla Immaiah
42265	Nandanavanam Raghavan
42266	Muhammad Abdul Rahiman
42267	Kondapalli Prasada Rao
42268	Kakumanu Veeranjaneyulu
42269	Vanapalli Appala Raju
42270	Lakhan Prasad
42271	Kuchimanchi Bhadri Raju
42272	Ghanashyam Chetia
42273	Jalasutram Venkata Rao
42274	Potharaju Chidambara Rao
42275	Veeramalla Bheemaraju
42276	Nagavarapu Mandeswara Rao
42277	Madhavapanicker Jayaraman
42278	Meruga Venkata Narayana Rao
42279	Valaparla David Prathap Prasad Rao
42280	Yenugadhati Kaviraja Ganga Prasad
42281	Nagiredla Venkataramanareddi
42282	Nattey Papa Rao
42283	Batchu Venkateswara Rao
42284	Peddu Gnaneswara Prasad
42285	Khaja Moinuddin
42286	Pagadala Sarangapany
42287	Koppolu Manikyam Setty
42288	Upendranath Baral
42289	Mahendra Kumar
42290	Nandana Kumaraswamy
42291	Pusarla Prakasa Rao
42292	Kotta Venkateswara Babu
42293	Gadicherla Mohan Rao
42294	Upadrasta Venkatasastrulu
42295	Palli Solomon Herald Suvarna Kumar
42296	Jakametti Karunakararao Clement
42297	Marella Nageswara Rao
42298	Pothuri Venkatasiva Rao
42299	Chintagunta Muralidhar
42300	Namasivayan Arumuga Nainar
42301	Aruna Kumar Nadakuditi
42302	Undrakonda Kutumba Rao
42303	Shiva Narayan Yadava
42304	Pothapragada Venkata Vidyadhara Rao
42305	Chintalury Venkata Krishna Rao
42306	Medury Victory Prasad Premnath Bob
42307	Kode Venkateswarulu
42308	M. Abdul Qyoom
42309	Bongarala Nageswara Rao
42310	Gollapudi Satchidanandam
42311	Malayil Mathai John
42312	Boyanapalli Bocham Rao
42313	Gojjala Sadanandam Chetty
42314	Ganta Andrews Jai Raj
42315	I. V. Seshasai Mangapathi Harinatha Babu
42316	Vencherla Krishna Rao
42317	Tridandapani Giri Babu
42318	Divakarla Srinivasa Rao
42319	Bapanapalli Venugopal
42320	Garikimukkala Suvarna Raju
42321	Mohindar Singh Chauhan
42322	Vaman Balkrishna Lele
42323	P. Munuswami Naidu
42324	Gangasani Ranga Reddy
42325	Sharad Keshavrao Karmarkar
42326	Chathelil Radhakrishnan
42327	Abdul Hameed Khan
42328	Nagula Yelliah Swamy
42329	Lloyd D. Silva
42330	Ramesh Kumar
42331	Jagdish Kumar Singh
42332	Patinhara Covilakam Manavedan Raja
42333	Manohar Gangadhar Makoday
42334	Krovvidy Krishnamurty
42335	Vemula Rama Mohana Rao
42336	Pratap Narain Srivastava
42337	Korrapolu Sambasivareddy
42338	Potula Krishna Reddy
42339	Durbha Venkata Rangayya
42340	Umakant Shrivallabh Choudhary
42341	S. Kannan
42342	Sushil Kumar
42343	Narendra Kumar Jain
42344	Ved Parkash Makkar
42345	B. R. Srinivas
42346	Ganda Singh Brar
42347	Chiman Lal Garg
42348	Jai Kishan Singal
42349	Mohinder Lal Chand
42350	Nem Chand Jain
42351	P. R. Krishda Warrier
42352	Amrik Singh

STUDENTS (*contd.*)

No.	Name
42353	Meghraj Vyas
42354	Mohan Girdhar Lal Chandnani
42355	Mehar Chand Setia
42356	Pisipati Seetaramanjaneya Sarma
42357	Onkar Nath Pande
42358	Bhaskar Narayan
42359	P. Subramanian
42360	Pillamari Rajeshwar Rao
42361	Nittala Suryaprakasam
42362	Daljit Singh Badwal
42363	Govind Prasad Shyamlall Shrivastava
42364	Vir Bhan
42365	Chilveri Narayana
42366	Krishan Chand
42367	Dalip Singh Bumrah
42368	Gopisetti Rajagopala Rao
42369	Subbaiah
42370	Prabhu Nath Pandey
42371	Babu Ram
42372	Vishnu Datt Vasnik
42373	Pawan Kumar
42374	Kazim Husain
42375	Akirala Sadashiva
42376	Ram Lal
42377	K. J. Melvin
42378	K. Gopalakrishan Nair
42379	K. T. George
42380	Rajinder Singh Reehal
42381	Rajinder Paul Dugala
42382	Dadhiala Jagir Singh
42383	Santosh Kumar Saraswat
42384	Manmohan Krishan Sawhney
42385	Satya Pal Jain
42386	Abnash Chand Goel
42387	Suresh Chandra Tiwari
42388	Manoharlal Mahajan
42389	Jaleshwar Singh
42390	Krishnaiyangar Seshadri
42391	C. R. Chandrasekharan
42392	Mam Chand Gupta
42393	Chittineni Sambasiva Rao
42394	Kamla Prasad
42395	Tulsi Das Khubchandani
42396	Tadiparti Satyanarayana
42397	Gopal Singh
42398	Krishna Kumar Khanna
42399	Mohindar Singh Brar
42400	Sudhir Kumar Talwar
42401	Sajja Jayaramaiah
42402	Mekala Subbaramaiah
42403	Gurmit Singh
42404	Alok Ranjan Bhadra
42405	Talari Gopala Krishnarao
42406	Raghavendra Vamanacharya Nagarhalli
42407	Balmuri Narayan Rao
42408	Jhingade Dayashankar Gnaneshwara Rao
42409	Jayakoti Swaminathan
42410	M. S. Satya Narayana Vara Prasada Rao
42411	Prasad Manjunath
42412	Kalmadi Narendra Kumar
42413	Krishna Gopal Gupta
42414	Dasary Krishna Kumar
42415	Thambehally Krishnaswamy Sreenivasan
42416	Gotigere Sridhara Murthy
42417	Venkareddi Bheemareddi Kalahal
42418	Setlur Rangaswamy Biligiri Vasan
42419	Mandayam Pratapan
42420	Padmanabharao Balakrishna
42421	Haniyur Subbanna Srinivasa
42422	N. Ramanathasastry Sreenivasa Murthy
42423	Alur Sivananjappa Jayaprasad
42424	Koratagere Ramaseah Suri Babu
42425	Parthasarathi Balakrishna
42426	Madanapalli Subbarao Gopinath
42427	Antony Rasquinha
42428	S. Krishna Raju
42429	Hebbale Subbarayan Kumar
42430	C. Srinivasa Murthy
42431	Mysore Ramasastry Subba Krishna
42432	Akshayakumar Bansilal Dhruva
42433	Maddur Narasimhachar Subbanna
42434	Mandyam Ammanjee Krishnan
42435	Manur Purushottama
42436	Puttu Venkatachalapathysetty Nandakumar
42437	Ramaswamy Ranga Raju
42438	Motegowda Thimme Gowda
42439	Rudrapatna Nagappa Chandrashekara
42440	Venkatasubba Gopal Hedge
42441	Setlur Vasudevan Sreenivasan

STUDENTS (*contd.*)

No	Name
42442	Subbarayasastry Kasinatha Sastry
42443	Bhatrahalli Krishnarao Sripada Rao
42444	Kackadasam Raghavachar Sreenath
42445	Kallamadi Krishna Murthy
42446	Velide Narasimha Murthy
42447	Chintamani Bhimasenarao Haranath
42448	Narasimhachar Rajanna
42449	B. V. Raman
42450	K. Srinivasadesikachar Jaya Ram
42451	Bangalore Venkatachar Varadarajan
42452	Varlakonde Adiseshaiah Sreedhara
42453	Rangappa Subbarao Krishna Murthy
42454	Bachali Raghavendrarao Keshava Rao
42455	Subbabhatta Ramasastry Rama Subbaiah
42456	Gammu Murali
42457	Huruli Dwarakanath Achyutha Rao
42458	Shamiahraju Jayakar
42459	Haltore Seetharamaiyengar Rangarajan
42460	Marulasiddaiah Vagisha Sharma
42461	Rangachar Rajagopal
42462	Theganahalli Neelakantaiah Sreekantaiah
42463	Venkataraman Kumara Swamy
42464	Daniel George
42465	Nowratan Singh
42466	Palagummi Suryanarayana Murty
42467	Rachakonda Venkata Rao
42468	P. P. Ahammed
42469	Sundareswara Iyer
42470	Vancheswaraiyer Bhaskar
42471	Sattiraju Lakshmi Narasimham
42472	Puthumana Subramanian Embrandiri
42473	Ramachandrannair Madhavan Nair
42474	A. Narayana
42475	Narussan Kunjukrishnan
42476	Veeramoneyiyer Narasimha Iyer
42477	Magadi Seetharamarao Ranganath
42478	Cukkemane Sadashivarao Vishwanath
42479	Bagapalli Srinivasarao Madhu Rao
42480	B. Sesha Iyer
42481	S. Chamarajan
42482	C. Narayanan
42483	Namala Stephen Jayaraj
42484	Srinivasan Sunder Raj
42485	Vadakoot Kunjitty Balakrishnan
42486	Josyula Subrahmanyasastri
42487	Rupakula Kasi Viswanadam
42488	K. N. Balakrishnan
42489	R. Neelakanta Sarma
42490	V. Lonappan Kochouseph
42491	H. Rajagopal
42492	Yerramsetti Venkata Rao
42493	Shubh Kumar Suri
42494	Pilanku Veetil Gopalan
42495	M. A. Leelanathan
42496	C. I. Gopi
42497	Palpoo Ramachandran
42498	Mohammad Turab Ali Khan
42499	V. V. Vasudeva Kaimal
42500	Mohmmed Abdul Basit
42501	Baru Raghavendra Rau
42502	Satnam Singh Kundi
42503	P. Divakaran Pillai
42504	Katragadda Sambasiva Rao
42505	Ram Saran Ahuja
42506	Nutakki Nageswara Rao
42507	Girdhari Lal Kalra
42508	Mohinder Singh Mann
42509	Arvind Bachubhai Damani
42510	Yogeshwar Prasad Nautiyal
42511	Terugu Radha Krishna
42512	K. A. Joseph
42513	Sarwat Alam Khan
42514	Panjala Rajaiah
42515	V. K. Thankappan
42516	D. Francis Yesudas
42517	K. Lakshminarayanan
42518	Syed Yusufuddin
42519	K. Ramani
42520	V. V. Satyanarayana Murty
42521	Chavali Ramagopala Murthy
42522	Tella Hari Babu
42523	Sunderaraj Erudyaraj George
42524	Abdul Latif Khan
42525	Puthurth Sukumaran
42526	Puthenkalathil Mathew Chacko
42527	Kanjirappallil Chacko George
42528	Jagdish Singh Jangi
42529	Pachava Ramaiah
42530	Kripal Singh
42531	Panachayil Chacko Jacob

STUDENTS (*contd.*)

No.	Name	No.	Name
42532	Satyanarayana Rao	42577	Ramaswamy Rajagopalan
42533	Sunkara Krishna Rao	42578	R. Sankara Iyer
42534	Kuriakose Korah	42579	Maddipatla Krishna Rao
42535	Ganti Sri Ramachandra Murthy	42580	Aeredla Papi Reddy
42536	Kaukutla Chandra Reddy	42581	Nukala Venkatramulu
42537	Malkapuri Arjun Singh	42582	Amalendu Das
42538	Kodemela Shravan Kumar	42583	Pullela Sitaramayya
42539	A. N. Rama Murthy	42584	Syed Bahaouddin Hussaini
42540	Kota Venkata Suryanarayana	42585	Prem Singh Dhingra
42541	P. S. Raveendran	42586	Badepalli Hari Rao
42542	Kotra Eashwaraiah	42587	Padmanabhasastrigal Lakshmanan
42543	Harihara Veeramani	42588	Kondapaka Shivalingam
42544	Narinder Parkash Bansal	42589	Amar Singh
42545	Pankaj Mathuradas Kapadia	42590	Gauri Sankar Sen
42546	Pulparambil Shanmukhadas	42591	S. Sankara Varier
42547	Pritpal Singh Arora	42592	S. Rangarajan
42548	Bhupinder Kumar Dham	42594	Atchutuni Sreenivasa Rao
42549	Vishwa Mitter Sharma	42595	Chumbalkar R. Nagaraja Rao
42550	Maddali Mohan Rao	42596	Cheriya Nagagath Abdulla Koya
42551	Malliah	42596	Yash Paul Parricha
42552	Kemmankandath Abdulla	42598	Neerakal Jacob Korah
42553	Ratnakaram Anjaneya Raju	42599	Kunjukrishna Sankara Narayana Pillai
42554	Madugundu Venkateswarlu	42600	D. Jeyaraj
42555	Tata Venkata Narayana	42601	Peddireddi Ranga Rao
42556	M. Neelakandhan Nambisan	42602	Dasari Gopalakrishna
42557	Yogesh Chand	42603	K. V. Kunhikannan
42558	Ukkru Varkey Paul	42604	R. Velayudhan Pillai
42559	Surapaneni Venkata Narasimha Rao	42605	Surendra Prasad Srivastava
42560	P. R. Viswambharan	42606	Mohammed Abdul Qadir Khan
42561	Mihirkanti Bandyopadhyay	42607	Krishan Lal Gidar
42562	Arcot Narasingarao Dayakar Rao	42608	Kappurum Ramakrishna
42563	Kollu Janardana Rao	42609	Puthenveedu Sivasankaran Harigopan
42564	Maddala Umamaheswar Rao	42610	Kari Brahmaji Prasad
42565	Mulukala-Sanjeeva Rao	42611	Udayavarmaraja Gopalakrishnan Nair
42566	Puthenparampil Alex	42612	Surinder Singh
42567	Surrendar Kumar Sharma	42613	Kanakanchi Pattabhi Ramaiah
42568	Kuruvilla Samuel	42614	Kesiraju Subbarao
42569	Saripalli Venkatachalam	42615	Nimma Linga Reddy
42570	G. Sasi Kumar	42616	Attar Singh Rathee
42571	T. T. V. Bhaskaran	42617	Rudolph Paul
42572	Enjeti Jayanth	42618	Gondham Sri Ramulu
42573	Pandurang Kulkarni	42619	Medala Narayan Swamy
42574	Chilukuri Jaggaraju	42620	M. Mohamed Sheriff
42575	Durvasula Marthanda Sastry	42621	Kurumampuzha Narayanan Raghavan
42576	Pindiproli Ramachandra Rao	42622	Krishnarao Rama Rao

STUDENTS (*contd.*)

No.	Name
42623	P. Venkata Krishna Seetaramachandra Murti
42624	Karpuram Kumar
42625	Somareddi Prabhakara Reddi
42626	Thomas Cheriyan
42627	A. P. Kurian
42628	Varkey Veepanattu Mathai
42629	Abdul Razzaq Khan
42630	Sudershan Kumar Gupta
42631	Parangodan Vijayan
42632	Mahesh Chandra Goel
42633	Sudershan Kumar Anand
42634	Katta Nageswara Rao
42635	Daggupati Madhavaiah
42636	Thomas Mathew
42637	Ananthkishan Pandojirao Dhage
42638	B. Sripathi Rao
42640	Syed Shakeel Ahmed
42641	Koshal Nath Mehta
42642	Yendamuri Mrutyunjaya Rao
42643	Mannemela Gopal Reddy
42644	Baldev Singh Sidhu
42645	Dinesh R. Nanavati
42646	Kanhirathinkal Mathew Varghese
42647	P. P. Baby
42648	T. Ramannair Ramachandran Nair
42649	Durga Dass
42650	Chandan Singh
42651	V. Balasubramaniam
42652	Korukonda Subrahmanyeswararao
42653	Lokanandi Pankaj Kumar
42654	Dattatraya Gopal Bedkar
42655	P. M. Sebastian
42656	Khaja Noorul Hasan
42657	Keelary Cherumanalil Ravindran
42658	Voleti Venkata Rama Narasimhachary
42659	Atam Prakash Dhal
42660	Boyina Jagdeeshwar Rao
42661	Yenamandra Varaha Narasimham
42662	K. Parameswarannair Unni Krishnan Nair
42663	Manmohan Singh
42664	Bishamber Dass Sharma
42665	Yoginder Kumar Bakshi
42666	Kranti Kumar Karaiya
42667	Shanker Prasad Dube
42668	Jai Dayal Suchdev
42669	Gobind Lal Kataria
42670	Ved Prakash
42671	Amarjit Singh Grewal
42672	Sital Gianchand
42673	Tirukkovalluri Sobhanadri
42674	Ramesh Chander Saighal
42675	Velayudhan Sadanandan
42676	Karra Tata Rao
42677	S. Sankaranarayan Krishnan
42678	Ashok Kumar
42679	Saliamangalam Ramakrishna Rajaraman
42680	Telikicherla Nageswara Rao
42681	Kuppili Venkata Satyanandam
42682	Bal Krishna Sharma
42683	Satish Prasad Mehrotra
42684	Atam Parkash Hans
42685	M. L. Balarajan
42686	Randhir Chand
42687	K. P. Nandakumaran
42688	Kewal Krishan
42689	Tara Singh
42690	Mahendra Kumar Jain
42691	Bhupinder Singh Herar
42692	Manak Chand Lalchand Jain
42693	Subhash Chandra Manchanda
42694	Prem Narayan Gupta
42695	Boorgu Chandriah
42696	P. Rajendran
42697	P. V. Kuriakose
42698	Govind Singh
42699	Nagaraja Narasimhan
42700	Surendar Singh Dhama
42701	Raj Kumar Sharma
42702	Mahesh Chandra Puri
42703	Yoginder Singh Katoch
42704	Mahawadi Prabhakar
42705	Muthakun Suryanarayanarao
42706	Narinder Krishan Bhanot
42707	Madan Lal Satija
42708	Sudarshan Kumar Gulhati
42709	Madan Lal
42710	Baldev Singh Randhawa
42711	Rameshwar Das
42712	Arjun Dev

STUDENTS (*contd.*)

No.	Name
42713	Moti Lal Uttamchandani
42714	N. V. Subramanya
42715	Emmadi Anantham
42716	Lal Singh Verma
42717	Brijeshwar Kumar
42718	Sudershan Kumar Syal
42719	Devender Nath Sharma
42720	Ravi Chandra Arya
42721	Bal Krishan Rajput
42722	Arjun Lal
42723	Kanahaya Lal
42724	Rattan Kumar Gupta
42725	Trilok Singhmudher
42726	Varanasi Ramachandra Rao
42727	Kashi Ram Dewangan
42728	Dwarka Nath
42729	Amarjit Singh Sandhu
42730	Jagtar Singh Jagdeo
42731	Gadudasu Rama Das
42732	Yellati Sudershan Reddy
42733	Sham Sunder
42734	Harbans Lal Minocha
42735	Sandhyavandanam Jagannatha Rao
42736	R. Narayanan
42737	Sosale Krishan Jois Suryanarayana
42738	Arvind Nilkanth Naik
42739	Vinayak Narayan Kelkar
42740	Vaideeswaran Sundararaman
42741	Amrik Singh Binepal
42742	Tayi Dwaraka Nath
42743	Prabhala Radhakrishnamoorthi
42744	Thekkethil Jayadevan Nedungadi
42745	Radha Raman Saxena
42746	Balkrishna Gajanan Sharma
42747	Phul Singh
42748	Pasham Muthyalu
42749	Puthenpurackal Joseph Varghese
42750	Sat Paul Medan
42751	Karan Singh
42752	Joginder Singh
42753	Balbir Singh Deswal
42754	I. S. Sreedharan
42755	Thiriyat S. Gopinathan
42756	Gurpal Singh
42757	Vijay Kumar Kukreja

No.	Name
42758	P. C. Mathew
42759	Chanan Singh Jaswal
42760	Shashikant Tamhane
42761	Kammari Gangiah Kasinath
42762	Mengho Bhagwandas Bhatia
42763	Balijepalli Ranga Rao
42764	Kuldip Kumar Sehgal
42765	Ujjager Singh
42766	Yarra Sivaprasada Chenna Malleswara Rao
42767	Bhyravabhotla Lakshminarayana
42768	M. M. John
42769	Prem Kumar Bhatia
42770	Thilakkandy Chalakkandy Mohammad Kunhi
42771	Gurbaj Singh
42772	Chandra Bhushan Shrivastava
42773	Bela Singh
42774	Tata Mrithyunjaya Rao
42775	Melmanavoor Sundaresawaraiyer Ganesan
42776	Thotapalli Chandra Sekhar Sarma
42777	Balbir Singh
42778	Ishtiaq Hussain Siddiqui
42779	Lakshmanaiyer Sankara Iyer
42780	Bhup Singh Yadava
42781	Hari Singh Virdee
42782	Avinashi Ram Vig
42783	Ram Parkash Bawa
42784	Kuldip Chader Mennan
42785	Gurumukh Moorijmal Parwani
42786	Ramesh Chander Malhotra
42787	Ram Kishan
42788	C. J. Joseph
42789	Jagdish Chandra Panchal
42790	Izran Mohammed Khan
42791	Gopi Krishan Dhyani
42792	Krishan Dev Sharma
42793	Tara Chand Gera
42794	Manjit Singh
42795	Awadh Sharan Vyas
42796	Nemmeni Meenakshisundaram Ramakrishnan
42797	Nanik Bhagwandas Ahuja
42798	Amajit Singh Jabbal
42799	Jagdish Kumar Tandon

STUDENTS (*contd.*)

No.	Name
42800	Govinda Sahai Shrivastava
42801	Suresh Krishna Ponkshe
42802	Chandrakant Narandas Ashar
42803	Alakhya Chandra Mohanty
42804	Subhas Chandra Saha
42805	Santi Ranjan Mukherjee
42806	Bhajan Chandra Kanrar
42807	Barundeb Mitra
42808	Asharfi Jha
42809	Shibnarayan Sen
42810	Manjit Singh Chandhok
42811	Harekrushna Khuntia
42812	C. E. Socrates
42813	Ramendra Kishore Roy
42814	Manharlal Kachulal Shah
42815	Salilendu Mukherjee
42816	Virendra Kumar Mathur
42817	Sakti Das Chatterji
42818	Balaram Bisboyi
42819	Manas Kumar Mukhopadhyay
42820	Madhukar Deorao Mushrif
42821	Gadadhar Satpathy
42822	Gaura Chandra Mishra
42823	Gouri Shankar Deb
42824	Yudhisthir Prusti
42825	Sourindra Prasad Bagchi
42826	Ananthanarayanaiyer Hariharan
42827	Krishna Narahari
42828	Konchada Lokanadham Subudhi
42829	Sudarsan Panda
42830	Varanasi Krishna Mohan Rao
42831	Niranjan Behara
42832	Chandravadan Ratilal Patel
42833	Narasingha Satpathy
42834	Vishweshwar Dayal Agrawal
42835	Daya Chand Amar
42836	Suryanarayana Ratha
42837	Cpl. Prakasha Nand Dubey
42838	Rampal Singh Kunwar
42839	Dalvir Singh
42840	Virendra Kumar Chaudhary
42841	Prabir Kumar Roy
42842	Prem Chandra Gupta
42843	Raghubir Dayal Chaturvedi
42844	Viswanathan Krishnamoorthi
42845	Uma Charan Dash
42846	Bhaiya Murli Manohar Lal
42847	Suresh Chand Jain
42848	Janki Sharan
42849	Sharda Prasad
42850	Sohan Singh Sandhu
42851	Vinod Kumar Nigam
42852	Hukam Chand Karwal
42853	Mahendra Singh Thakur
42854	Desh Raj Singh Chauhan
42855	Tara Datt Padalia
42856	Dibya Singh Nanda
42857	Nimaicharan Mohanty
42858	G. Janardhan
42859	Shrish Chandra Gupta
42860	M. N. Srinivasa Iyengar
42861	Naresh Behari Lal
42862	Virendra Kumar
42863	C. K. Ramanathan
42864	Jagannath Sahu
42865	Saghirul Haq Soleja
42866	Sheo Kumar Shukla
42867	Sarjit Singh Munday
42868	Mahesh Kumar Khurana
42869	Krishna Gopal Sharma
42870	Pawan Kumar Jain
42871	Surendra Kumar Ahuja
42872	Shashi Kant Kulshrestha
42873	Vishwa Bandhu Jahary
42874	Syed Imtiyazuddin Desnavi
42875	Bhagaban Panda
42876	Ajit Kumar Bhattcharyya
42877	M. R. Soneja
42878	Bhupinder Singh Sethi
42879	Babu Singh
42880	Kirti Kishore Chaudhari
42881	Hari Ratna Ranjitkar
42882	Pramesh Kumar
42883	Kanai Chand Majumdar
42884	Dilip Kumar Kar
42885	Dipakkumar Mukhopadhyay
42886	Syamal Kumar Pal
42887	Amiya Kumar Mukhopadhyay
42888	Shivnath Paranandi
42889	Ajit Kumar Das

STUDENTS (*contd.*)

No.	Name
42890	Sankarkumar Mukhopadhyay
42891	Kartik Chandra Ghosh
42892	Sankar Bijoy Bhattacharjee
42893	Tapan Kumar Ghosh
42894	Nirmal Kumar Guha Neogi
42895	Nirmalya Bhattacharya
42896	Nimai Chand Biswas
42897	Achinta Kumar Banga
42898	Achintya Kumar Roy
42899	Karam Chand
42900	Kalyan Kumar Sen Gupta
42901	Sitesh Chandra Bhattacharjee
42902	Asok Kumar Bandyopadhyay
42903	Biswanath Ray
42904	Sasibhusana Baitho
42905	Niladrinath Bagchi
42906	Bidyaghar Mallick
42907	Harish Chandra Agarwal
42908	Hari Pal
42909	Madan Gopal
42910	Shambhu Nath Mukerji
22911	Ram Kumar Kulshreshtha
42912	Manindranath Sen
42913	Anindya Kumar Ghosh
42914	Kamalendra Ganguly
42915	Pranab Kumar Bandyopadhyay
42916	Rashed Ullah Khan
42917	Ashok Nandalal Baser
42918	Somanath Mohapatra
42919	Amaresh Chandra Ghosh
42920	Bodhimana Maharana
42921	Harshadray Chhanalal Shah
42922	Gurpur Raghunath Kamath
42923	Ved Prakash
42924	Ramesh Chandra Sharma
42925	Dinesh Kumar
42926	Gwali Charan
42927	Veerabhadra Sankaran
42928	Sewak Saran Sharma
4929	Kripa Shanker
42930	Prankanta Bhattacharyya
42931	Amar Sankar Khanna
42932	Aminur Rahman
44933	Prabhat Chandra Debnath
42934	Ajit Ghose
42935	Tapas Kumar Bandyopadhyay
42936	Bimal Kumar Khan
42937	Ashis Kumar Maitra
42938	Debabrata Mitra
42939	Ajit Kumar Sen
42940	Hemanta Sankar Bhattacharya
42941	Ashis Kumar Bhattacharjya
42942	Ashoke Kumar Ghosh
42943	Hari Pada Chattopadhyay
42944	Samar Nath Maitra
42945	Bimal Kanta Das
42946	Prodip Kumar Sen Gupta
42947	Munawwar Hosain
42948	Mrinalkanti Guha
42949	Ramamrit Mazumder Chowdhury
42950	Rajendra Mohan Mehrotra
42951	Rameshchandra Shantilal Parikh
42952	Satish Chandra Kamthan
42953	Lakhai Chandra Gaur
42954	Ramesh Chandra Agarwal
42955	Santosh Raj Dhaul
42956	Hasitkumar Harivadanbhai Parikh
42957	Madhusudan Manilal Shah
42958	Mohammed Habif Hamid Faras
42959	Ram Bhaj Breja
42960	Khushi Ram
42961	Rajendra Himmatlal Shah
42962	Dilip Pranlal Shah
42963	Abbas Mohsinbhai Unwala
42964	Hasmukhlal Fulchand Shah
42965	Ram Kumar Aggarwal
42966	Roshan Lal
42967	Jagdishcandra Jayantilal Sanghani
42968	Indulal Chunilal Parmar
42969	Parshottam Prabhudas Patel
42970	Bangalore Narasimhamurthy Rama Prasad
42971	N. Tirunarayanaiyengar Sathyanarayana
42973	Pravinchandra Jekishandas Patel
42972	Ajit Balasaheb Pawar
42974	Surjit Singh
42975	Bhopal Singh
42976	Nallur Venkatesaiyer Natarajan
42977	Kothapeta Veeramarasetty Suryanarayana
42978	Krishnamurthy Sridhara
42979	Sita Ram Pandey

STUDENTS (*contd.*)

No.	Name
42980	Ramaswami Bala Subra Mani
42981	Rajnikant Pranvallabh Bhatt
42982	Girish Kantilal Shah
42983	Jagdish Shivshankar Pandya
42984	Navin Chandra Bhatia
42985	Arthur Dennis
42986	Girishchandra Khodidas Suchdev
42987	Mayampurath Jayamohan
42988	Abdus Salam
42989	T. Kamal Kumar
42990	Stanslus William Solanky
42991	Malali N. Ramanna
42992	T. V. Krishnamurthy
42993	Madhusudan Laxman Gokhale
42994	Bhanubhai Kalyanbhai Patel
42995	Iqbal Dutta Mehta
42996	Thuruthippallil Chacko Kurien
42997	Prahladbhai Shankerlal Patel
42998	Kollengode Vaidyanathan Ananthanaraynan
42999	Girishkumar Jivaraj Tank
43000	Narayansetty Rajeevalochana
43001	Pundi Krishnaswamy Ramu
43002	Chimanlal Purushottamdas Patel
43003	Monotosh Surendranath Banerjee
43004	Jagatsingh Vishindas Choithramani
43005	Bhaskerrai Shivshanker Vyas
43006	Mahendra Himatlal Shah
43007	Chandrakant Ratilal Patel
43008	A. Sreenath
43009	P. Seetharamanjaneya Ranga Bhaskara Rao
43010	M. Ramadasarao Vijaya Gopala Das
43011	Sulukunte Ramanujiengar Padmanabhan
43012	Vijaykumar Yeshwant Rege
43013	Mohan Vasant Shiravadekar
43014	Sreekant Tryambak Khatankar
43015	Chandrasekhariah Ramamurthy
43016	Addagadde Krishnamurthy Srikanta
43017	Conjeevaram Ramanathan Ramamurthy
43018	N. Shanmugam
43019	Hallymysore Subbaraya Prabhakara
43020	Vaddagiri Gopala Rao
43021	Manubhai Ranchhodlal Patel
43022	Krishnamurthy Panduranga Rao
43023	Francis Furtado
43024	Moosabba Beary
43025	Shamaiyengar Krishna Murthy
43026	Belur Seetharamaiyengar
43027	Shrikrishna Narhar Kalkar
43028	Adivarahan Vaideeswaram Iyer
43029	Chaturbhai Babaldas Patel
43030	Bhagavatlal Jaswantlal Bhatt
43031	Baldevbhai Jivram Suthar
43032	Hari Pratap Singh
43033	Bangalore Krishnarao Prahlada Rao
43034	Girishchandra Chhaganlal Shah
43035	Attaver Umesh
43036	Yelahawka Lakmipathysastry Satyanarayan
43037	K. Narasimhatatachar Madhavan
43038	B. Venkatachalasastry Sreenivasa Murthy
43039	Bindahalli Javaregowda Anne Gowda
43040	Aarukalva Narasimharaghavan
43041	Pushpavadan Jashwantlal Shah
43042	Dahyabhai Purshottam Patel
43043	Pralhad Anant Mulgund
43044	G. L. Kadam
43045	Bhasker Edwin Paramanand
43046	Sukh Dev Rakheja
43047	Dharam Vir Saihgal
43048	Krishnamurthy Venkataramaiah
43049	Lakhbir Singh Bhalla
43050	Jaswantlal Laherchand Shah
43051	K. T. Ahmed
43052	Rajnikant Chimanlal Shah
43053	Fakirappa Gangappa Jalgar
43054	Arvind Amritlal Vagadia
43055	Vibhakar Dattatraya Kharkar
43056	Pravin Keshavlal Krastiya
43057	Bhimasben Anantrao Kulkarni
43058	Govindasamy Krishnaswamy
43060	Siddiqui Salahuddin Ahmed
43061	Bhanarlal Girdharlal Bhavsar
43062	H. Ramachandrarao Narasimha Murthy
43063	Balkrishna Giriraj Gosavi
43064	Canchi Goturu Sadasiva Sarma
43065	Sagri Manjunath Surendra
43066	P. S. Jayaram
43067	Anilkumar Jamnadas Patwari
43068	R. Victor Thyagaraj

STUDENTS (*contd.*)

No.	Name
43069	Prakashnarayan Shridhar Kotnis
43070	Subramaniyam Rajagopalan
43071	Ganjigutte Venkatesha Nagaraja Iyer
43072	Hassan Narayanarao Ranganath
43073	Sultan Mohiyuddin Khan
43074	Thazhath Veettil Gopalan
43075	Hebbalu Ramarao Hanumantha Rao
43076	Subbabhatta Narasimha Murthy
43077	Rajkumar Bhagwandas Bhatia
43078	Mohan Kisharam Java
43079	Divate Siddappa Panduranga
43080	Himanshoobhai Ramanlalbhai Thakor
43081	Mandaleeka Gurucharanamrutha Rao
43082	R. Upendra
43083	Vinodrai Vrajlal Mehta
43084	Jiwat Lokumal Motwani
43085	K. P. Jagannatha Gupta
43086	Nuggehalli Kowsic Satyan
43087	K. A. Viswanathan
43088	Bockapatna Ramesh
43089	Rama Shanker
43090	Kishore Vithal Kantebet
43091	T. R. Gopala Krishna Rao
43092	Kanakapura Ananthaiah Ramanna
43093	Panchanan Ghosh
43094	Amal Krishna Chakravarti
43095	Manuprasad Harilal Upadhyay
43096	Basalingappa Channabasappa Kotturashettar
43097	Thakorbhai Dahyabhai Patel
43098	Bhupendrakumar Nagindas Shah
43099	Maneklal Sababhai Gurjar
43100	Sanyasisingh Hanuman Singh
43101	Grama Ramasetty Srinivasa
43102	Panna Lal Dwivedi
43103	Mathamsetti Narayana Rao
43104	Madhusudan Prabhudas Patel
43105	N. R. Padmanabhan
43106	Muthuswamy Balakrishna
43107	Ramaiyer Pattabhi
43108	Kirit Manubhai Desai
43109	N. R. Venkata Krishna Setty
43111	Sibi Narasimha Murthy
43112	Yarlagadda Seshagiri Rao
43113	Stanley Ajit Thomas
43114	Chitrapura Balasubrahmanya
43115	M. Thomas Jayakumar
43116	Kanaiyalal Narandas Gandhi
43117	Subhash Ramachandra Ranadive
43118	Baliram Madhavrao Desai
43119	Krishnarao Achutha Rao
43120	Ashokchandra Brijaratanlal Shah
43121	Oozhunnllore Ninan Baby
43122	M. J. Rama Prasad
43123	T. R. Hanumantha Rao
43124	Jayawant Dayaram Pathare
43125	Shivanand Nagappa Pattan
43126	S. R. Biligiri
43127	Hasmukhlal Chunilal Shah
43128	P. V. Raveendranathan Nayar
43129	Himesh Harinand Mehta
43130	Shankaranarayana
43131	Om Parkash Gambhir
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43133	Madan Lal Malhotra
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43135	Narendrabhai Natavarlal Mehta
43136	Chandrakant Rupchand Bhatia
43137	Varghese George
43138	Harshadkumar Ambalal Parikh
43139	Hemchandra Ganesh Patwardhan
43140	Haridas Govardhandas Mantri
43141	Byrappa Balakrishna
43142	Jayarama Sharma
43143	Rameshchandra Shantilal Vyas
43144	Swaminathan Balakrishnan
43145	Kishore Ramesh Kallianpur
43146	Mannil Oommen Oommen
43147	Kannadathil Bhaskaran Nair
43148	Ramaniklal Chunilal Vora
43149	Ramesh Chander
43150	Prabir Datta
43151	Bimal Kanta Ray
43152	Benedict Victor D'souza
43153	Prabodhkumar Sadashiv Dave
43154	Nand Srichand Narang
43155	William Sebastian Hisquitta
43156	Chander Naraindas Lund
43157	Bal Krishan Bhardwaj
43158	Yogendra Mohan Rastogi
43159	Suresh Gangaram Mhapankar

STUDENTS (*contd.*)

No.	Name
43160	Ramchandra Krishnarao Kulkarni
43161	Amrutlal Hargovandas Patel
43162	Ranjitbhai Madhabhai Patel
43163	Thazhakatthouse Prabhakaran
43164	Khalil Ahmed Ansari
43165	Herbert Peter Walker
43166	Taracad Venkatachalam Venugopalan
43167	Sunder Singh
43168	Madhukar Vitthalrao Sonavant
43169	Madan Lal
43170	Sudhir Kumar Gupta
43171	Shaileshkumar Harsumanrai Mehta
43172	Kalyan Kumar Chaudhuri
43173	Shreeram Wasudeo Marathe
43174	Prabhakar Krishnaji Bhirangi
43175	Mahesh Chandra Nigam
43176	Kumud Ranjan Datta
43177	Mihir Kumar Mitra
43178	Prafull Harikrishana Padhya
43179	Ramesh Chandra Srivastava
43180	Pondichery Hamadri
43181	Manohar Baliram Waghmare
43182	Ashok Digamber Galande
43183	Arayamudhadikshidar Parthasarathy
43184	Shrikant Ramkrishna Patankar
43185	Shantilal Chhitabhai Patel
43186	Jagdish Prasad Garg
43187	H. S. Ranga Swamy
43188	Ripdaman Singh
43189	Sandur Karnic Vasudevachar
43190	Kirpa Ram
43191	Vasabhai Virchandbhai Patel
43192	Gajendra Ratilal Mehta
43193	Eswarnath Lingarkar
43194	Narayanaswamy Jayaraman
43195	S. S. Radhakrishnan
43196	K. Swaminathan
43197	Thomas Emerald Samuel
43198	Madhur Gopala Krishna Iyengar
43199	Keshav Vasudev Khare
43200	P. N. Krishnan
43201	Vishnu Hirojee Satam
43202	Subhashchandra Shantaram Samarth
43203	Mohamed Hafiz Abdul Kadir Mujavar
43204	Devanarayanan Ramasubramanian
43205	Mahadeo Bapu Shinde
43206	Dharam Vir Gupta
43207	Dilbagh Singh
43208	Narasinh Ram Hegde
43209	Dilipsen Vijaysen Tamhane
43210	Narinder Kumar Bali
43211	Devi Prasad Maikhuri
43212	Gajanan Vishwanath Deshpande
43213	Placido Luis Vaz
43214	Amalendu Mazumdar
43215	Gour Krishna Dey
43216	Mittar Gopal
43217	Ram Singh
43218	Narinder Paul
43219	Krishan Kumar Sharma
43220	Vidya Sagar
43221	Sat Pal
43222	Govind Singh Sharma
43223	Ram Narain
43224	Mahesh Chander Dhawan
43225	Parshotam Lal Sachdeva
43226	Joginder Pal
43227	Ram Sarup Singh
43228	Surender Kumar Butta
43229	Baldev Krishan Verma
43230	Adiveppa Venkappa Jadhav
43231	M. Bhadri Raju
43232	V. Venkata Satya Suryanarayanamurty
43233	Sammeta Rama Subbarao
43234	Kundam Seetharami Reddy
43235	Maragadapuram Srinivasa Sundararajan
43236	Rattan Mani Sewal
43237	Chandrakant Narahari Gokhale
43238	Har Bhagwan
43239	Madan Lal Pramami
43240	Adhir Kumar Sen
43241	Ranbir Singh Yadav
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43244	Divi Umamaheswara Rao
43245	D. Singaravelu
43246	T. P. John
43247	V. Vaidyanathaiyer Subramanian
43248	Krishnamurthi Venkatagiri
43249	A. Somasundaram

STUDENTS (*contd.*)

No.	Name
43250	M. Muralikrishna Reddy
43251	Swaminathan Thiagarajan
43252	Om Prakash Sethi
43253	Pagadala Mallikarajan Rao
43254	Venkatachala Easwaramurthi
43255	Ramamirtham Rajagopalan
43256	Ramaiyengar Krishnaswamy
43257	Chittaranjan Das
43258	Ramamurti Balasubramanian
43259	Chandra Sekhara Mishra
43260	T. Manickamudaliar Sambandam
43261	Chandra Prakash
43262	Metharatta Paul Abraham
43263	Jamesar Sahoo
43264	Ammanathu Padmanabhan Viswambharan Nair
43265	Lalgudi Narayanan Srinivasan
43266	Natarajan Srinivasan
43267	Ramaswamy Alagaperumal
43268	Madurantakam Saravanam Shanmugam
43269	V. Viswanathan Subramanian
43270	Gummanur Madhava Rao
43271	Krishnamoorthi Balaraman
43272	V. N. Balasundaram
43273	S. K. L. Raju
43274	Ratnasamynadar Durairaj
43275	Gurumoorthy Venkatachalam
43276	Periangkuppam Ramaseshan Seshadri
43277	Seetharamasarma Srinivasan
43278	Venumamalai Sundara Raj
43279	Rajagopalan Krishnaswami
43280	Selvadhas Retnadhas
43281	Kishore Chandra Sahoo
43282	V. Shenbagarajan
43283	Shakti Bhushan Abbhi
43284	Arun Charan Parida
43285	Thirugami Ramaswami Shunmugam
43286	B. Lakshmana Venkataraman
43287	Krishnaswamy Narasimhan
43288	Kalluru Ramamoorthy
43289	Ananthanarayanan Ramavaidyanathan
43290	Ramadurai Gopalakrishnan
43291	Narasingolu Venkata Narasimha Rao
43292	Mohiuddin Alam
43293	Uma Sankar Das
43294	A. K. Mohamed Hassan
43295	Narayanathevar Sabapathi
43296	L. S. Kuppusamy
43297	Chandrasekhar Mishra
43298	Bulusu Bhaskar
43299	Sarangan Sridharan
43300	M. S. Venkateswaran
43301	Muthuswami Lakshminarasimhan
43302	Sabhanam Rama Krishna Rao
43303	M. Seenu
43304	R. M. Arunachalam
43305	Kallakuruchi Vedavyasarao Balaram Rao
43306	Sundaresa Panchapakesan
43307	A. Annamalai
43308	S. Perumalsamy
43309	Yogender Singh Bisht
43310	K. Kamalaksha Kamath
43311	V. K. Sankaran
43312	D. Narayanan
43313	R. Balasubramanian
43314	Sndararaja Rajagopalan
43315	Ajoouka Maniraj
43316	Chollangi Rama Chandra Rao
43317	N. Vaitheeswaran
43318	Krishna Ayyaswami
43319	Balakrishnan Srikumar
43320	V. K. Kuppuswamy
43321	Ramachandrarao Srinivasan
43322	K. V. Jacob
43323	S. Sundararajan

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20; except where otherwise stated.

SITUATIONS WANTED

ELECTRICAL ENGINEER, B.E. (Hons.), A.M.I.E., trained in works in Switzerland, having experience in all branches of electric power supply engineering, planning, erection, testing and maintenance of sub-stations, lines and generating stations, maintenance of all electrical equipment like switchgear, relays, etc., and well versed in protection systems, also 13 years experience with State Electricity Boards, Tata Hydroelectric Companys desires a change. (Office ref. E.S. 155)

MECHANICAL ELECTRICAL ENGINEER, B.Sc. (Eng.), A.M.I.E., age 50, 27 years experience in metallurgical, chemical, textile industries, and big thermal power stations, of which 4 years as Chief Engineer in a composite textile mill, 7 years as power station Superintendent and Manager 67.5 MW capacity plant and 1 year as Superintending Engineer for efficiency, control and plant troubles, *viz.*, inspection of thermal power stations of State Electricity Board. Travelled abroad on technical assignment. Excellent health. Desires fulltime position or consultation on power, steam, and fuel efficiency. Available immediately. (Office ref. E.S. 156)

YOUNG CIVIL ENGINEER, B.E., A.M.I.E., age 29 years, with over 8 years practical experience in the works of building construction, irrigation projects surveys, construction of hill roads in difficult terrain, quarrying, blasting and working with heavy earthmoving equipments; Member of Indian Road Congress, Institution of Military Engineers, Member International Association of Bridge and Structural Engineering; presently drawing Rs. 650 with free boarding and lodging facilities, serving as Class I Gazetted Officer, Government of India, seeks change in private or Government concern for suitable family stations on reasonable terms, anywhere in India inclusive of Nagaland and Nepal or outside country. (Office ref. E.S. 157)

QUALIFIED AND EXPERIENCED CIVIL ENGINEER, Corporate Member of the Institution of Engineers (India), more than 28 years with two eminent firms of building contractors in Calcutta, and now working at a four figure salary in one of Asia's premier industrial concerns near Calcutta with expansion programme, seeks change. (Office ref. E.S. 158)

STUDENT of the Institution of Engineers (India), B.A., with Mathematics; Diploma in Draughtsmanship (Civil) with 79% marks; Section A of the Associate Membership examination of the Institution of Engineers (India) securing 71% marks. Can design various types of R.C.C. structures and draw them with a good workmanship. Worked for 3½ years in Department of Atomic Energy and working in a reputed firm of Consulting Engineers; seeks suitable change anywhere in India. Salary expected is around Rs. 450. (Office ref. E.S. 159)

YOUNG FIRST CLASS DIPLOMA HOLDER in Electrical Engineering, B.Sc., passed Section A of the Associate Membership Examination of the Institution of Engineers (India), age 26 years, having 3 years experience in installation, maintenance and repairs of flame proof electrical equipment, at present drawing Rs. 350 desires to change over to production line of H.T. and L.T. switchgear, preferably around Bombay or Calcutta. (Office ref. E.S. 160)

STUDENT of the Institution of Engineers (India), age 40 years, passed Sections A and B of the Associate Membership examination and completed a specialized course in Foundation Engineering of the University of Roorkee in 1964, and having 19 years experience in the Civil Engineering Department of the railways, specialized in the construction of buildings, permanent way and bridges; desires a prospective job in any reputed engineering concern. (Office ref. E.S. 161)

STUDENTS INTENDING TO APPEAR IN NOVEMBER 1964 ASSOCIATE MEMBERSHIP EXAMINATIONS (EXISTING AND NEW SCHEMES) PLEASE SEE NOTICE ON PAGE 38 AND APPLICATION FORMS AT THE END OF THIS BULLETIN

BULLETIN OF
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OF
ENGINEERS (INDIA)

Vol. 13, No. 10, JUNE 1964

Supplement to the *Journal of the Institution of Engineers (India)*,
Vol. 44, No. 10, June 1964

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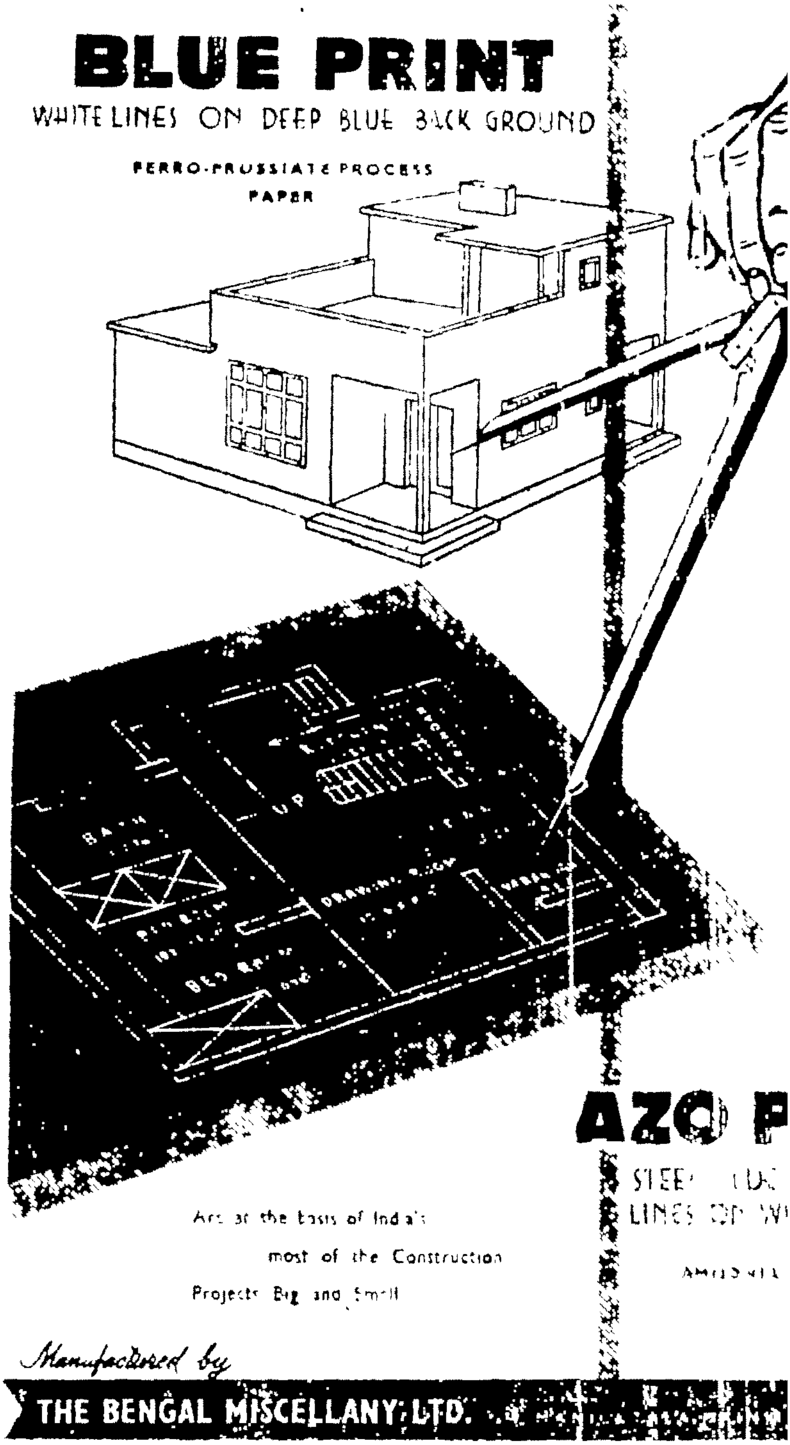

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The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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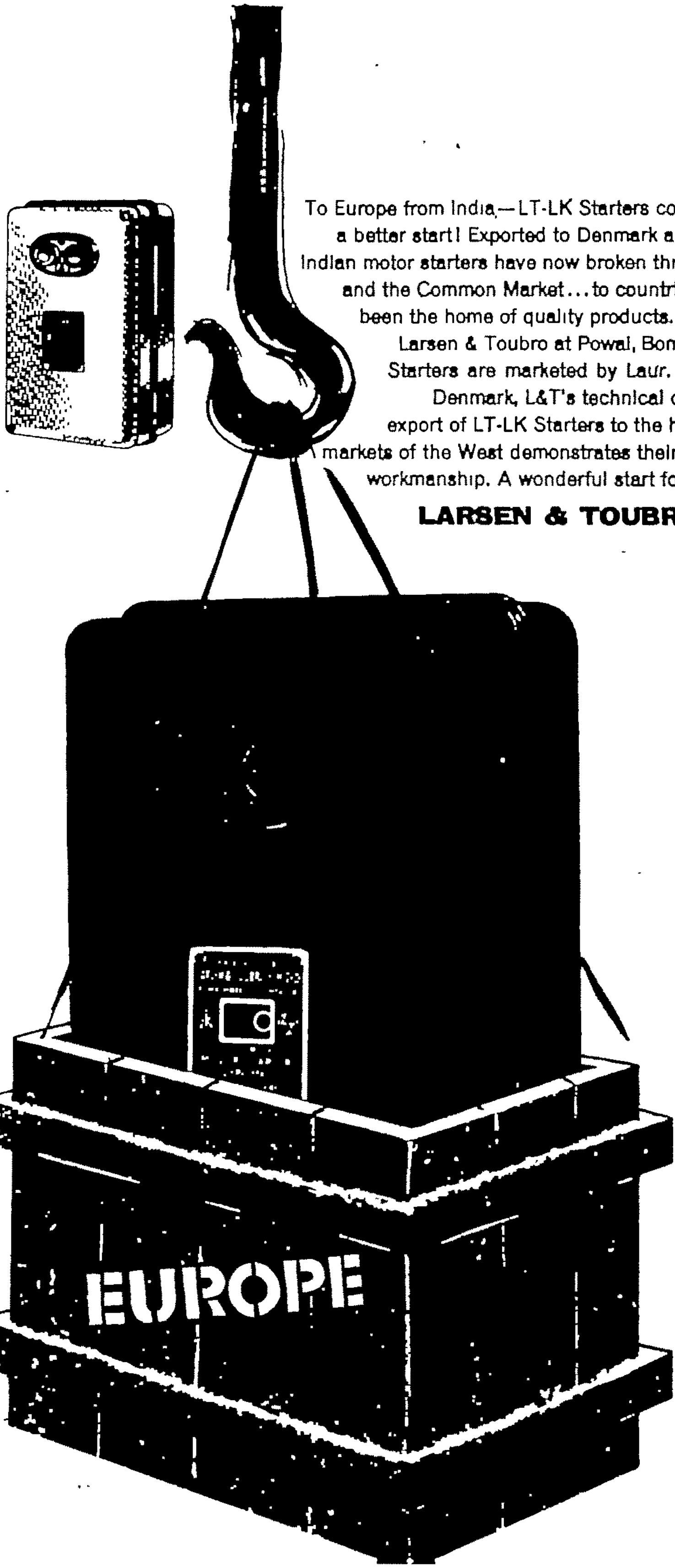

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MINUTES OF THE SPECIAL GENERAL MEETING OF CORPORATE MEMBERS HELD IN BANGALORE ON SATURDAY, MAY 23, 1964

A Special General Meeting of the Corporate Members of the Institution was held in the building of the Mysore Centre of the Institution, Vidhana Veedhi, Bangalore, on Saturday, 23rd May, 1964, at 9.30 a.m. to consider revisions to the Regulations of the Council which had been proposed by the Council of the Institution and which had been recommended by the Council to the Corporate Members at their 434th Meeting held in Hyderabad on 11th February, 1964.

Dr. T. Sen, President, was in the Chair. The attendance of Corporate Members was 66.

Proceedings

The President welcomed the members to the Meeting, and gave a brief background which led the Council to propose revisions to the Regulations.

He said it was known to members that on 19th October, 1963, the Bye-laws of the Institution were revised and a new set of Bye-laws was adopted. It became necessary, therefore, that the Regulations of the Council should also be revised to bring them in line with the new Bye-laws.

Accordingly, the Council at their 431st Meeting held in Calcutta on 20th October, 1963, appointed a Committee consisting of Sarvashri J. Datt (*M.*), Dildar Husain (*M.*), Prof. N. S. Govinda Rao (*M.*), V. Y. Kamat (*M.*) and S. Varadaraja Sarma (*M.*), to which Shri T. R. Mehandru (*M.*) was later co-opted, to draft the new Regulations in accordance with the spirit of the new Bye-laws.

The Committee met twice, first in Bangalore on 29th and 30th November, 1963, and then in Delhi on 11th and 12th January, 1964, and the draft revised Regulations were discussed by the Council at their 434th Meeting held in Hyderabad on 11th February, 1964. The Council considered the draft Regulations in great detail and with some modifications decided to recommended them to the Corporate Members for consideration at a Special General Meeting in accordance with the provision of Bye-law 82(b)(i), for which purpose, he said, they had now gathered. The draft revised Regulations were printed in the February 1964 issue of the *Bulletin*, which he continued, was already in the hands of members.

He then said he would particularly like to mention the concept of Divisional representation in the composition of the Local Centre Committees, as the new Bye-laws had adopted this Divisional representation in the Council, in order that the various engineering disciplines had their autonomy.

Also, the President said it may not be out of place to mention here that as far as subscriptions were concerned, the Council had felt that since the Corporate Members at a Meeting held in Delhi on 31st March, 1962, had adopted the new rates of subscription, they should be left as they were, and the proposals now presented were also as they were. He concluded by saying he hoped that members had given their thoughts to the Regulations which were before them for their consideration.

He once again thanked the members for having taken the trouble of coming from different parts of the country to attend this Meeting.

He then invited Shri J. Datt (*M.*), a member of the Committee appointed to revise the Regulations, to move that they be adopted.

Shri J. Datt (*M.*) said that before he moved the Regulations of the Council before the Meeting for adoption, he would like to draw the attention of the Meeting to certain printing mistakes. These were the following :

In Regulation 8, end of line 6, 'the' should read 'one' ; in Regulation 11, line 2, 'Council' should read 'Committee' ; in Regulation 12, line 3, 'Regulation 3' should read 'Regulation 13' ; in Regulation 13, at the end of this Regulation in the second paragraph, the words 'of the Local Centre' should be added after the words 'assigned to them by the Committee' ; in Regulation 15(f), line 2, 'him' should read 'them' ; in Regulation 15(g), last line, the words 'Board of' should be added between the words 'the' and 'scrutineers' ; in Regulation 24, line 4, 'He' should read 'They' ; on page xvii, the Regulation numbered '33' should read '38' ; on page xx, the figures of subscriptions and other fees should read exactly as on the opposite page xxi ; in Regulation 50, line 3, the words 'towards general office charges' should be deleted ; in Regulation 60, line 1, the word 'life' should be added between the words 'The table of' and 'compounding fees' ; and in Regulation 73, last line, the word 'Honorary' should be added between the words 'the' and 'Secretary'.

Shri Datt then said that in addition to these corrections, he would also like to draw the attention of the Meeting to certain alterations suggested by the Solicitors of the Institution, Messrs. Sandersons and Morgans, as the Solicitors had felt that these would be improvements in the text and bring about compactness if accepted. These were the following :

In Regulation 1, the following sentence should be added at the end of this Regulation : 'The said geographical boundaries should be analogous to the boundaries of the States and Union Territories of the Indian Union'. ; in Regulation 2, line 2, the word 'automatically' should be substituted by the words 'deemed to be' ; also, in Regulation 2, line 3, the word 'usually' should be added between the words 'boundaries of which he' and the words 'resides or is in employment' ; again, in Regulation 2, the second paragraph of this Regulation should be brought immediately after the first sentence of the Regulation ; in Regulation 5, lines 4 and 5, the words 'which have been duly summoned and held in accordance with the Charter and the Bye-laws and' should be deleted ; in Regulation 6, line 2, the words 'to be' should be added between the words 'But if this is not found' and the words 'possible due to' ; in Regulation 7(b), line 2, the words 'entitled to vote' should be added between the words 'all Corporate Members of the Local Centre' and the words 'calling upon each of them' ; in Regulation 7(f), line 1, the words 'unopened' and 'envelopes' should be transposed to read 'envelopes unopened' ; in Regulation 7(g), line 1, the words 'the said' should be added between the words 'after the expiry of' and the words '21 days' ; in Regulation 13, line 17, the words 'to him' should be added between the words 'from the date of posting it' and the words 'by the Secretary'; in Regulation 15(b), line 2, the words 'entitled to vote' should be added between the words 'all Corporate Members of the Local Centre' and the words 'calling upon each of them'; in Regulation 15(f), line 1, the words 'unopened' and 'envelopes' should be transposed to read 'envelopes unopened'; in Regulation 15(g), line 1, the words 'the said' should be added between the words 'after the expiry of' and the words '21 days'; in Regulation 60, lines 2 and 3, the words 'and without applying the provisions of Bye-law 72 of prior approval by a Special General Meeting of Corporate Members' should be deleted so as to make the Regulation read as a single sentence; Regulations 61 and 62 should be deleted as they were ultra vires of Bye-law 39; and in Regulations 5, 13, 30 and 37, lines 4, 3, 4 and 2 respectively, the words 'the Regulations' should be added between the words 'the Charter, the Bye-laws' and the words 'and the Resolutions of General Meetings of Corporate Members'.

Shri Datt then proposed that the above corrections and the alterations suggested by the Solicitors be adopted. Shri B. R. Manickam (*M.*) seconded the proposal.

The President put the proposal of Shri Datt seconded by Shri Manickam to the Meeting. The Meeting unanimously accepted the above corrections and suggested alterations by the Solicitors as proposed by Shri Datt.

At the stage Shri S. Padhi (*M.*) felt that following the deletion of Regulations 61 and 62, the Regulations following thereafter should necessarily have to be re-numbered accordingly. This was carried by the Meeting unanimously.

The President then said that if any member wished to move amendments to any particular Regulation, he would be glad to receive them.

The President then requested Prof. N. S. Govinda Rao (*M.*) to move the amendments received in the office of the Headquarters of the Institution from different members and the Local and Sub-Centres.

Prof. Govinda Rao said that in Regulation 2, paragraph 3, the Gujarat Centre would like the addition of 'but he shall have the option to be attached to the Local Centre of his choice where he had affiliations or interest' at the end of this paragraph. He said that before recommending the draft Regulations to the Council, the Committee appointed for the purpose discussed this matter in great detail and felt that this was not necessary. The Council also decided to adopt the Regulation as it was.

The President then put the above proposal of the Gujarat Centre to the Meeting. After discussion, the proposal was not approved by the Meeting.

Prof. Govinda Rao next said the Gujarat Centre had also proposed the addition of the following sentence: 'and there will be no seat for the Division in which the number of members is less than 25' between the words 'less than 100 Corporate Members' and the words' 'and the balance number' in line 5, second paragraph of Regulation 3. The President put the above proposal to the Meeting and it was not carried.

Prof. Govinda Rao then said that the Gujarat Centre had further proposed the substitution of the last line of paragraph 2, Regulation 3, by the sentence. 'In case where there are no seats for a particular Division, these seats will be filled up by members elected by all Corporate Members for that year'. The President put this proposal also to the Meeting, and it was not carried.

Prof. Govinda Rao then said that the Gujarat Centre had suggested the addition of the word 'present' between the words 'have it signed by all the scrutineers' and the words 'and present it', in Regulations 7(g) and 15(g), line 4. The President put this proposal to the Meeting and it was carried unanimously.

Prof. Govinda Rao said that the Gujarat Centre would also like to know what would happen if the Honorary Secretary was unable to attend the Meeting which was already convened, as in Regulation 13, page ix, line 10, it was stated 'he shall attend all Meetings of the Committee and shall have the business thereat correctly and fully recorded and reported'.

The President put the matter to the Meeting, and after discussion, the Meeting decided that the word 'normally' should be added between the words 'he shall' and the words 'attend all meetings of the Committee'.

Prof. Govinda Rao said the Honorary Secretary, Poona Centre, had suggested that the number in the Board of Scrutineers in Regulations 7(a) and 15(a) may be reduced from five to a smaller number, which feeling was also shared by the Honorary Secretary, Bihar Centre.

Thereafter, there was considerable discussion on the matter, and the President recommended to the Meeting that the Board of Scrutineers should consist of not more than five in number, but not less than three which shall form the quorum, and that the Board of Scrutineers should also appoint a Convener from amongst themselves. The Meeting unanimously accepted the President's recommendation and directed that the concerned Regulations may accordingly be suitably worded.

Prof. Govinda Rao said that he had received a suggestion that the following sentence may be added in Regulations 7(g) and 15(g), line 3, between the words 'to scrutinize the voting papers' and the words 'prepare their report on the results of the voting': 'rejecting voting papers that are defaced, tampered or interfered with unwarrantably, or obliterated in any way'.

The President then put the above amendment to the Meeting, and it was carried unanimously.

Prof. Govinda Rao said Shri S. Varadaraja Sarma (*M.*) had also sent the following amendments to be moved :

In Regulation 15(g), line 4, the words 'Honorary Secretary' should be substituted by the word 'Chairman'; in Regulation 15(h), line 3, the words 'Board of Scrutineers' should be substituted by the words 'Chairman of the Local Centre'

The President put the above amendments of Shri Varadaraja Sarma to the Meeting, and the amendments were carried unaniously.

Prof. Govinda Rao then said that the Honorary Secretary, Roorkee Sub-Centre, had suggested that in Regulation 29, the Committee of each Sub-Centre should be expanded by including two immediate Past-Chairmen of the Sub-Centre.

The President put the matter to the Meeting. After discussion, it was decided that the Committee of the Sub-Centre should be expanded by including the immediate Past-Chairman only, and Regulation 29 should read as follows :

'The affairs of each Sub-Centre can be conducted and the property and moneys thereof shall be administered by a Committee consisting of the Chairman and the Honorary Secretary of the Sub-Centre, the immediate Past-Chairman, and not more than seven Corporate Members attached to the Sub-Centre. The Chairman of the Sub-Centre shall be a Member'.

Prof. Govinda Rao next said that the Honorary Secretary, Roorkee Sub-Centre, had also sought a clarification between Regulations 32 and 33 on the following account. According to Regulation 32, the retiring Chairman would be in the Chair at the Annual General Meeting of the Sub-Centre at the time of election of the new Committee of the Sub-Centre. According to Regulation 33, the new Chairman of the Sub-Centre would take office at the Annual General Meeting of the Sub-Centre. The Honorary Secretary, therefore, wished a clarification as to which part at the Annual General Meeting would be presided over by the retiring Chairman and which part by the new Chairman.

The President put the above matter to the Meeting, and after discussion, the Meeting decided that Regulations 32 and 33 should be interchanged so as to read Regulation 32 as 33 and Regulation 33 as 32. The Meeting also decided to add the following sentence at the end of Regulation 32 (re-numbered 33) :

'The retiring Chairman shall thereafter instal the new Chairman of the Sub-Centre, elected in accordance with Regulation 32, as the Chairman of the Sub-Centre for the ensuing session.'

Then Shri Brijmohan Lal (*M.*) said he would like the addition of the words 'and the Hindi Section' between the words 'corresponding to the Divisions' and the words 'and the frequency of issue' in Regulation 64 (renumbered 62), line 1. He said he would also suggest the addition of the words 'and the Hindi Section' at the end of the first sentence in Regulation 67 (renumbered 65). Shri Arya Bhushan (*M.*) seconded the above amendments of Shri Brijmohan Lal.

The President then put the above amendments of Shri Brijmohan Lal to the Meeting. After discussion, the amendments were accepted by the Meeting.

Shri Datt then proposed that the Regulations as passed above at the Meeting be adopted with immediate effect. Prof. Govinda Rao seconded the proposal. This was carried unanimously.

In conclusion, the President thanked the Corporate Members for attending the Meeting and taking so much interest in the proceedings.

With a vote of thanks to the Chair, the Meeting terminated at 10.40 a.m.

REGULATIONS OF THE COUNCIL

of

The Institution of Engineers (India) made pursuant to Bye-law 72

LOCAL CENTRES

1. No Local Centre shall extend its activities beyond its geographical boundaries without the previous sanction of the Council, which sanction shall be only given after due notification to the Local Centre or Centres affected by such proposed extension of activities and after full consideration of any representations on the subject by such Local Centre or Centres. The said geographical boundaries should be analogous to the boundaries of the States and Union Territories of the Indian Union.

2. Every class of member of the Institution, save only the Honorary Members and the Honorary Life Members, shall be deemed to be attached to the Local Centre within the geographical boundaries of which he usually resides or is in employment or practises or carries on business. Temporary absence for a period not exceeding six months shall be exempted from the operation of this Regulation. The Council shall, however, have the discretion to exempt any member from this provision if he shows sufficient reason why he should be attached to a Local Centre other than the one to which he would be attached by its operation. A member so exempted shall not however hold any office in the Institution as representative of the Local Centre to which he is thus permitted to be attached.

Members residing or in employment or practising or carrying on business abroad or in Indian territory not within the geographical boundaries of any Local Centre shall be attached to the Headquarters.

3. The affairs of each Local Centre shall be conducted and the property and moneys thereof shall be administered by a Committee consisting of the Chairman and the Honorary Secretary of the Local Centre, two immediate Past-Chairmen, the Chairmen of any Sub-Centres within the boundary of the Local Centre, and twelve Corporate Members. Members of the Council attached to the Local Centre shall be ex-officio members of the Committee.

All the branches of engineering in which the Institution has established Divisions shall be represented in the persons of the twelve Corporate Members specified above such that two Corporate Members are elected from each of those Divisions to which are attached 100 or more Corporate Members, one Corporate Member is elected from each of those Divisions to which are attached less than 100 Corporate Members, and the balance number are elected by all the Corporate Members attached to the Local Centre. In the case where there are no Corporate Members in a particular Division at a Local Centre, the seat appropriate to that Division shall be kept vacant.

The Committee of the Local Centre may, however, co-opt additional Corporate Members for special purposes, but these persons shall have no vote in the Committee outside the special purpose for which they are co-opted and shall vacate their seats as soon as the special matters shall have been dealt with.

4. The quorum for a meeting of the Committee of a Local Centre shall be five.

5. The duties of the Committee of each Local Centre shall be to promote the general advancement of engineering science within its boundaries. The affairs of each Local Centre shall be conducted in accordance with the provisions of the Charter, the Bye-laws, the Regulations, and the Resolutions of General Meetings of Corporate Members duly recorded in the minutes of the meetings.

Subject to the above and subject to the authority of the Council, each Local Centre shall have the power to frame rules for the conduct of its own affairs. Such rules shall however receive the previous approval of the Council.

6. The Annual General Meeting of each Local Centre shall be held in November or December each year. But if this is not found to be possible due to unavoidable reasons, the prior permission of the Council shall be taken for any postponement. Fifteen days notice shall be given for the Meeting, and this period shall be exclusive of the day on which notice is deemed to be given but be inclusive of the day for which the notice is given. The Audited Accounts of the Local Centre and the Annual Report of the Committee for the preceding year shall accompany the notice. Only Corporate Members shall be entitled to attend. The Committee for the preceding session shall retire at the Annual General Meeting. The business of the Annual General Meeting shall be to receive the Audited Accounts and the Annual Report and the report on the elections to the Committee, and appoint Auditors and fix their remuneration.

7. (a) At least two months before the Annual General Meeting of each Local Centre, but not later than the 31st day of October, the Committee of the Local Centre shall appoint a Board of Scrutineers not more then five in number, but not less than three who shall form the quorum. The Board of Scrutineers shall also appoint a Convenor from amongst themselves.

(b) The Board of Scrutineers shall issue a notice to all Corporate Members of the Local Centre entitled to vote, calling upon each of them to propose within 15 days the names of Corporate Members, with their written consent, the Corporate Member considers as suitable persons for election as members of the Committee of the Local Centre. While so notifying, the Board of Scrutineers shall draw the attention of the Corporate Members to the number of seats allotted, in accordance with Regulation 3, to each branch of engineering in which the Institution has established a Division, and invite them to submit names for election taking this into account. Members of the retiring Committee shall be eligible for re-election, and this shall also be stated by the Board of Scrutineers while notifying the Corporate Members as above.

(c) The Board of Scrutineers shall thereafter circulate the names of those Corporate Members who have signified their consent to stand for election to each of them individually, and ask him to inform them within 10 days of the date of posting the letter in case he wishes to withdraw from the election.

(d) The Board of Scrutineers shall then prepare voting papers showing the names of Corporate Members willing to serve on the Committee if elected, and post them to the Corporate Members at their recorded addresses. Voting papers shall be returnable to the Board of Scrutineers within 21 days of the date of posting them.

(e) Any such notice served or sent by post shall be deemed to have been served or delivered at the expiration of ninety-six hours after it was posted.

(f) The Board of Scrutineers shall number and date the envelopes unopened containing the voting papers as they are received by them, and shall lodge them in a ballot box provided for the purpose. The ballot box shall not be removed from the office of the Local Centre under any plea whatsoever, and shall be in the personal custody of the Board of Scrutineers.

(g) The Board of Scrutineers shall, immediately after the expiry of the said 21 days from the date of posting the voting papers seal the ballot box and arrange to scrutinize the voting papers, rejecting voting papers that are defaced, tampered or interfered with unwarrantably, or obliterated in any way, prepare their report on the results of the voting, have it signed by the scrutineers present, and present it to the Chairman of the Local Centre. In the event of two members securing equal numbers of votes, the Board of Scrutineers shall decide by toss of coin, and in the event of more than two members securing equal numbers of votes, the Board of Scrutineers shall decide by drawing lots.

(h) The Chairman of the Local Centre shall announce the results of the voting at the Annual General Meeting of the Local Centre. Thereafter, the voting papers shall be sealed and kept by him for 30 days, whereafter they shall be destroyed.

8. Before every Annual General Meeting, the retiring Committee of each Local Centre shall elect one of their members who shall be a Member to be Chairman for the ensuing session. The person so elected shall take office as Chairman of the Local Centre at the Annual General Meeting of the Local Centre, and as a member of the Council at the next ensuing Annual General Meeting of the Institution. A Chairman of a Local Centre shall be eligible for re-election for a further period of office as Chairman for one session only, but after completion of his periods of office (of one session or two sessions as the case may be) he shall not be eligible for re-election.

9. Before every Annual General Meeting, the retiring Committee shall also elect one of their members to be Honorary Secretary for the ensuing session. The person so elected shall take office as Honorary Secretary of the Local Centre at the Annual General Meeting of the Local Centre. An Honorary Secretary of a Local Centre shall be eligible for re-election for further periods of office not exceeding four sessions in all, but after completion of this period he shall not be eligible for further re-election.

10. As soon as practicable after a new Chairman and the members of the new Committee of a Local Centre are elected, the Honorary Secretary of the Local Centre shall communicate their names to the Secretary.

11. Vacancies occurring in the Committee during any session may be filled up by the Committee by co-option. Such co-opted members of the Committee shall not be eligible for election as Chairman of the Local Centre under Regulation 8.

12. The Committee of a Local Centre shall, at their first meeting, appoint one or more Joint Honorary Secretary or Secretaries from the members of the Committee for the performance of duties described in Regulation 13.

13. The Honorary Secretary and the Joint Honorary Secretary or Secretaries of a Local Centre shall carry out all their duties always consistent with the provisions of the Charter, the Bye-laws, the Regulations, the Resolutions of General Meetings of Corporate Members, and the directions of the Council, and work under the direction of the Committee of the Local Centre and the general guidance of the Chairman. The Honorary Secretary shall be responsible for the conduct of all correspondence and office work of the Local Centre; he shall keep all accounts of the Local Centre and present them to the Committee at regular intervals; he shall forward monthly statements of accounts to the Secretary; he shall sign all cheques and make all disbursements in accordance with the provisions of the budget within the grant sanctioned by the Council for the Local Centre under Regulation 21; he shall maintain a register of all classes of members attached to the Local Centre and their addresses; he shall normally attend all meetings of the Committee and shall have the business thereat correctly and fully recorded and reported, and shall have copies of the minutes sent to the Secretary; he shall ensure that every application for membership received by his Local Centre from the Secretary shall be processed in accordance with Bye-law 25 as expeditiously as possible and returned to the Secretary within a period not exceeding six months from the date of posting it to him by the Secretary, and in the event of his failing to do so, the Secretary shall process the application in the manner specified in Bye-law 26 as if the application was received from a candidate resident abroad; he shall be responsible for the conduct of the Institution examinations at the Local Centre; he shall have charge of the library of the Local Centre; he shall have charge of all the properties in the custody of the Local Centre; and he shall generally conduct the ordinary business of the Local Centre, and shall refer to the Chairman in any matters of importance requiring urgent decision.

The Joint Honorary Secretary or Secretaries shall have such duties as may be assigned to them by the Committee of the Local Centre.

14. Each Local Centre shall elect from its Corporate Members such number of members of the Council as are allotted to the Centre under Bye-law 44. Such election shall be held by such a date as shall permit the Honorary Secretary of each Local Centre to communicate to the Secretary the names of the elected Corporate Members by the first day of November in each year. These Corporate Members shall take office as members of the Council at the next ensuing Annual General Meeting of the Institution.

A Corporate Member elected to the Council from a Local Centre leaving the geographical boundaries of the Local Centre shall cease to be a member of the Council, as provided in Regulation 2.

15. (a) The Honorary Secretary of each Local Centre, on receipt of a notification from the Secretary under Bye-law 50 calling upon the Local Centre to hold an election to fill vacancies in the Council other than casual, caused by retirements under Bye-law 49 or otherwise, shall arrange for the Committee of the Local Centre to appoint a

Board of Scrutineers not more than five in number, but not less than three who shall form the quorum. The Board of Scrutineers shall also appoint a Convenor from amongst themselves.

(b) The Board of Scrutineers shall issue a notice to all Corporate Members of the Local Centre entitled to vote, calling upon each of them to propose within 15 days the names of Corporate Members, with their written consent, the Corporate Member considers as suitable persons for election as members of the Council from the Local Centre. Members of the Council whose retirements may be causing the above vacancies shall be eligible for re-election, and this shall be stated by the Board of Scrutineers while notifying the Corporate Members as above.

(c) The Board of Scrutineers shall thereafter circulate the names of those Corporate Members who have signified their consent to stand for election to each of them individually, and ask him to inform them within 10 days of the date of posting the letter in case he wishes to withdraw from the election.

(d) The Board of Scrutineers shall then prepare voting papers showing the names of Corporate Members willing to serve on the Council if elected, and post them to the Corporate Members at their recorded addresses. Voting papers shall be returnable to the Board of Scrutineers within 21 days from the date of posting them.

(e) Any such notice served or sent by post shall be deemed to have been served or delivered at the expiration of ninety-six hours after it was posted.

(f) The Board of Scrutineers shall number and date the envelopes unopened containing the voting papers as they are received by them and shall lodge them in a ballot box provided for the purpose. The ballot box shall not be removed from the office of the Local Centre under any plea whatsoever, and shall be in the personal custody of the Board of Scrutineers.

(g) The Board of Scrutineers shall, immediately after the expiry of the said 21 days from the date of posting the voting papers, seal the ballot box and arrange to scrutinize the voting papers, rejecting voting papers that are defaced, tampered or interfered with unwarrantably, or obliterated in any way, prepare their report on the results of the voting, have it signed by the scrutineers present, and present it to the Chairman of the Local Centre. In the event of two members securing equal numbers of votes, the Board of Scrutineers shall decide by toss of coin, and in the event of more than two members securing equal numbers of votes, the Board of Scrutineers shall decide by drawing lots.

(h) The Honorary Secretary shall communicate the results of the election to the Secretary not later than the first day of November. The voting papers shall be sealed and kept by the chairman of the Local Centre till 30 days after the next ensuing Annual General Meeting of the Institution, whereafter they shall be destroyed.

16. In the event of a Local Centre failing to hold its Annual General Meeting in accordance with Regulation 6, the Council shall appoint Corporate Members from that Local Centre to constitute a Committee in accordance with Regulation 3, and such appointed Committee shall constitute the Committee of that Local Centre for the ensuing session,

with the same powers and responsibilities as if they had been duly elected in the ordinary course.

17. In the event of a retiring Committee of a Local Centre failing to elect one of their numbers to be Chairman for the ensuing session under Regulation 8, the Council shall appoint a Member of that Local Centre to be Chairman of the Local Centre for the ensuing session.

18. In the event of a retiring Committee of a Local Centre failing to elect one of their members to be Honorary Secretary for the ensuing session under Regulation 9, the Council shall appoint a member of that Local Centre to be Honorary Secretary of the Local Centre for the ensuing session.

19. In the event of a Local Centre failing to elect members to the Council under Regulation 14, the Council shall nominate members of that Local Centre to the Council for one session.

20. The proceedings of General Meetings of Local Centres shall follow, as far as applicable, the provisions of Bye-laws 90, 91, 92, 93 and 94, reading 'Chairman' for 'President' and 'member of the Committee of the Local Centre' for 'member of the Council'. The Corporate Members present shall be the quorum for the Annual General Meeting, and twenty Corporate Members for all other General Meetings.

21. From the funds of the Institution arrived at from the subscriptions of all classes of members, the Council shall allot each year to each Local Centre an annual grant. The accounts relating to this grant shall be open at all reasonable times to inspection by a duly accredited representative of the Council or by the Secretary or his representative.

22. The Committee of a Local Centre may raise from all classes of members attached to that Local Centre sums by subscriptions or otherwise for the purpose of extending the activities of the Local Centre or for the better attainment of the objects of the Institution as laid down in the Charter, provided such contributions are voluntary.

23. The Committee of a Local Centre may, further, accept movable or immovable property, goods, bequests or moneys from sources other than members, provided those sources have been approved by the Council.

24. The Committee of each Local Centre shall cause proper books of accounts to be kept and shall on the 31st day of August in each year close these books and have the accounts duly audited by an Auditor or Auditors qualified in accordance with Bye-law 60(ii). They shall forward to the Secretary a receipts and payment account duly signed by the Honorary Secretary and the Auditor or Auditors by the 15th day of October in each year.

25. The Honorary Secretary of each Local Centre shall prepare a budget of expenditure for each financial year and present it to the Committee of the Local Centre for approval. Thereafter, he shall forward it to the Secretary so as to reach him not later than the 30th day of June in each year. The annual grant to be paid to the Local Centre shall be determined by the Council in accordance with Regulation 21.

SUB-CENTRES

26. (a) Corporate Members not less than fifty in number residing or employed or practising or carrying on business in any contiguous area within the geographical boundaries of a Local Centre, desiring to converge and meet for pursuing the objects set forth in the Charter, may apply to the Local Centre concerned for recommending to the Council the formation of a Sub-Centre in that area.

(b) The Committee of the Local Centre shall give due consideration to such an application, and recommend it to the Council defining the geographical boundaries of the proposed Sub-Centre.

27. No Sub-Centre shall extend its activities beyond its geographical boundaries.

28. Every class of member, save only the Honorary Members and the Honorary Life Members, whose recorded address is within the geographical boundaries of a Sub-Centre shall be automatically attached to that Sub-Centre, without in any way affecting his attachment to the Local Centre within whose boundaries the Sub-Centre is situated.

29. The affairs of each Sub-Centre shall be conducted and the property and moneys thereof shall be administered by a Committee consisting of the Chairman and the Honorary Secretary of the Sub-Centre, the immediate Past-Chairman, and not more than seven Corporate Members attached to the Sub-Centre. The Chairman of the Sub-Centre shall be a Member.

The Chairman and the Honorary Secretary of the Local Centre within whose boundaries the Sub-Centre is situated shall be ex-officio members of the Committee.

The Committee of the Sub-Centre may co-opt additional Corporate Members for special purposes, but these persons shall have no vote in the Committee outside the special purpose for which they are co-opted and shall vacate their seats as soon as the special matters shall have been dealt with.

30. The duties of the Committee of each Sub-Centre shall be to promote the general advancement of engineering science within its boundaries. The affairs of each Sub-Centre shall be conducted in accordance with the provisions of the Charter, the Bye-laws, the Regulations, and the Resolutions of General Meetings of Corporate Members.

Subject to the above and subject to the approval of the Committee of the Local Centre within whose boundaries the Sub-Centre is situated, each Sub-Centre shall have the power to frame rules for the conduct of its own affairs.

31. The Annual General Meeting of each Sub-Centre shall be held in November of December each year. But if this is not found possible due to unavoidable reasons, the prior permission of the Committee of the Local Centre concerned shall be taken for any postponement. Fifteen days, notice shall be given for the Meeting, and this period shall be exclusive of the day on which the notice is deemed to be given but be inclusive of the day for which the notice is given. The Audited Accounts and the Annual Report of the Committee for the preceding year shall accompany the notice. Only Corporate Members shall be entitled to attend. The Committee for the preceding

year shall retire at the Annual General Meeting. The business of the Annual General Meeting shall be to receive the Audited Accounts and the Annual Report and the report on the elections to the Committee, and appoint Auditors and fix their remuneration.

32. Before every Annual General Meeting, the retiring Committee of each Sub-Centre shall elect one of its members who shall be a Member to be the Chairman for the ensuing session. The person so elected shall take office as Chairman of the Sub-Centre at the Annual General Meeting of the Sub-Centre. A Chairman of a Sub-Centre shall be eligible for re-election for a further period of office as Chairman for one session only, but after completion of his periods of office (of one session or two sessions as the case may be) he shall not be eligible for re-election.

33. The Committee of the Sub-Centre shall be elected each session at the Annual General Meeting of the Sub-Centre. The retiring Chairman shall invite nominations from the Corporate Members of the Sub-Centre present at the meeting, and the election shall be conducted by a majority show of hands. The retiring Chairman shall thereafter instal the new Chairman of the Sub-Centre, elected in accordance with Regulation 32, as the Chairman of the Sub-Centre for the ensuing year.

34. Before every Annual General Meeting, the retiring Committee shall also elect one of its members to be Honorary Secretary for the ensuing session. The person so elected shall take office at the Annual General Meeting of the Sub-Centre. An Honorary Secretary of a Sub-Centre shall be eligible for re-election for further periods of office not exceeding three sessions in all, but after completion of this period, he shall not be eligible for further re-election.

35. As soon as practicable after a new Chairman and the members of the new Committee of a Sub-Centre are elected, the Honorary Secretary of the Sub-Centre shall communicate their names to the Honorary Secretary of the Local Centre within whose boundaries the Sub-Centre is situated and the Secretary.

36. Vacancies occurring in the Committee during any session may be filled by the Committee by co-option.

37. The Honorary Secretary shall carry out all his duties always consistent with the provisions of the Charter, the Bye-laws, the Regulations, the Resolutions of General Meeting of Corporate Members, and the directions of the Council, and work under the direction of the Committee of the Sub-Centre and the general guidance of the Chairman. The Honorary Secretary shall be responsible for the conduct of all correspondence and office work of the Sub-Centre; he shall keep all accounts of the Sub-Centre and submit them to the Committee at regular intervals; he shall forward monthly statements of accounts to the Honorary Secretary of the Local Centre; he shall sign all cheques and make all disbursements in accordance with the provisions of the budget within the grant sanctioned by the Council for the Sub-Centre under Regulation 42; he shall maintain a register of all classes of members attached to the Sub-Centre and their addresses; he shall normally attend all meetings of the Committee and shall have the business thereat correctly and fully recorded and reported, and shall have copies of the minutes sent to the Secretary and the Honorary Secretary of the Local Centre concerned; he shall be responsible for the conduct of the Institution examinations at the Sub-Centre; he shall have charge of the library of the Sub-Centre; he shall have charge of all the

properties in the custody of the Sub-Centre; and he shall generally conduct the ordinary business of the Sub-Centre, and shall refer to the Chairman in any matters of importance requiring urgent decision.

38. In the event of a Sub-Centre failing to hold its Annual General Meeting in accordance with Regulation 31, the Committee of the Local Centre within whose boundaries the Sub-Centre is situated shall appoint Corporate Members from that Sub-Centre to constitute a Committee in accordance with Regulation 29, and such appointed Committee shall constitute the Committee of that Sub-Centre for the ensuing year, with the same powers and responsibilities as if they had been duly elected in the ordinary course.

39. In the event of a retiring Committee of a Sub-Centre failing to elect one of their members to be Chairman for the ensuing session under Regulation 33, the Committee of the Local Centre within whose boundaries the Sub-Centre is situated shall appoint a Member of that Sub-Centre to be Chairman of the Sub-Centre for the ensuing session.

40. In the event of a retiring Committee of a Local Centre failing to elect one of their members to be Honorary Secretary for the ensuing session under Regulation 34, the Committee of the Local Centre within whose boundaries the Sub-Centre is situated shall appoint a member of that Sub-Centre to be Honorary Secretary of the Sub-Centre for the ensuing session.

41. The proceedings of General Meetings of Sub-Centres shall follow, as far as applicable, the provisions of Bye-laws 90, 91, 92, 93 and 94, reading 'Chairman' for 'President', 'member of the Committee of the Sub-Centre' for 'member of the Council', and ten Corporate Members constituting the quorum.

42. From the funds of the Institution arrived at from the subscriptions of all classes of members, the Council shall allot each year to each Sub-Centre, through the Local Centre within whose boundaries the Sub-Centre is situated, an annual grant. The accounts relating to this grant shall be open at all reasonable times to inspection by a duly accredited representative of the Committee of the Local Centre concerned or of the Council or by the Secretary or his representative.

43. The Committee of each Sub-Centre shall cause proper books of account to be kept and shall on the 31st day of August in each year close these books and have the accounts duly audited by an Auditor or Auditors qualified in accordance with Bye-law 60 (ii). He shall forward to the Honorary Secretary of the Local Centre concerned a receipts and payments account duly signed by the Honorary Secretary and the Auditor or Auditors by the 1st day of October in each year.

44. The Honorary Secretary of each Sub-Centre shall prepare a budget of expenditure for each financial year and submit it to the Committee of the Sub-Centre for approval. Thereafter, he shall forward it to the Honorary Secretary of the Local Centre concerned so as to reach him not later than the 15th day of June in each year. The Honorary Secretary of the Local Centre shall incorporate these proposals in his budget of expenditure for the Local Centre prepared in accordance with Regulation 25.

DIPLOMAS AND CERTIFICATES

45. (a) Every Member and Companion shall on election receive a Diploma of membership appropriate to his class signed by the President, a member of the Council, and the Secretary, and sealed in accordance with Bye-law 104.

(b) Every Associate Member shall on election receive a Diploma of membership signed by the President and the Secretary, and sealed in accordance with Bye-law 104.

(c) Every Affiliate Member, Graduate and Student shall on election receive a Certificate of membership appropriate to his class signed by the Secretary.

46. Every such Diploma or Certificate shall remain the property of, and shall on demand be returned to, the Institution.

47. Every Member, Associate Member, Companion and Graduate is entitled to place after his name the designation of the class in the Institution to which he belongs, stated in accordance with the following abbreviated forms, namely, M.I.E., A.M.I.E., Comp. I.E., Grad.I.E.

PROFESSIONAL CONDUCT

48. Corporate Members shall be guided by the Code of Ethics for Corporate Members framed by the Council. The Council shall have the power to revise or modify this code from time to time as they deem fit.

SUBSCRIPTIONS AND OTHER FEES

49. The annual subscriptions, entrance and transfer fees, and life compounding fees payable by the various classes of members shall be as set out in the following tables.

Annual subscriptions

Class of Member	Amount
Member	Rs. 80
Associate Member	Rs. 50
Companion	Rs. 100
Affiliate Member	Rs. 50
Graduate	Rs. 40
Student	Rs. 35
Subscriber	Rs. 250

Entrance fees

Class of Member	Amount
Member	Rs. 75
Associate Member	Rs. 60
Companion	Rs. 60
Affiliate Member	Rs. 45
Graduate	Rs. 30
Student	Rs. 15

Transfer fees

Class of Member	Amount
Student to Graduate	Rs. 15
Student to Associate Member	Rs. 60
Graduate to Associate Member	Rs. 60
Associate Member to Member	Rs. 75

Life compounding fees

Age next birthday	Member Rs.	Associate Member Rs.	Companion Rs.
26		665	
27		660	
28		654	
29		646	
30		639	
31		630	
32		623	
33		614	
34		604	
35		595	
36	934	585	1,169
37	917	573	1,145
38	897	560	1,121
39	876	548	1,095
40	857	535	1,071
41	832	521	1,041
42	809	505	1,011
43	780	489	977
44	753	471	941
45	725	453	907
46	693	433	867
47	657	410	821
48	620	388	775
49	582	364	727
50	540	338	675
51	497	310	619
52	449	281	561
53	399	249	499
54	345	215	431
55 and over	284	179	356

Note :—Members, Associate Members and Companions who have attained the age of 55 years or over and have retired from active duty may compound their future annual subscriptions at the following rate :

Member	.. Rs. 250
Associate Member	.. Rs. 150
Companion	.. Rs. 310

50. Every candidate for election as Member, Associate Member, Companion or Affiliate Member shall pay a registration fee of Rs. 10 and every candidate for election as Graduate or Student shall pay a registration fee of Rs. 6, which shall not be refundable, irrespective of whether the candidate is elected or otherwise. The registration fee shall in all cases accompany the application for membership.

51. All annual subscriptions shall be due on the first day of September in each year for the year then commencing. The acceptance of an annual subscription from a person who has ceased to be a member shall not create any presumption as to membership of the Institution.

52. All annual subscriptions shall be paid to the Institution direct and not to or through a Local Centre or Sub-Centre.

53. Every candidate for election as Corporate Member shall pay entrance fee and first annual subscription as Associate Member. If elected as Member, he shall, on notification by the Secretary of election in accordance with Bye-law 29, pay the Institution the difference between the entrance fees and annual subscriptions as Member and Associate Member forthwith. The date of election shall be the date of approval by the Council. A candidate who fails to secure election shall be entitled to the return of his entrance fee and first annual subscription as Associate Member, without interest thereon and after deducting Rs. 5 as general office charges.

54. Every person elected as Companion, Affiliate Member, Graduate or Student and every applicant attached as Subscriber shall, on notification by the Secretary of election or attachment in accordance with Bye-laws 29 and 30 respectively, pay the Institution the appropriate entrance fees and first annual subscription forthwith. The date of election or attachment shall be the date of approval by the Council, but his name shall be entered on the Roll and he shall be entitled to any of the rights and privileges of the Institution only upon such payment being made. If he fails to pay such fees and subscription within three months of his notification by the Secretary under Bye-laws 29 and 30, his election or attachment shall be liable to cancellation.

55. The first annual subscription of a member in any class elected or attached after the last day of February shall be one-half of the annual subscription appropriate to that class under Regulation 49.

56. Any member in any class whose subscription for the current year shall not have been paid before the first day of November shall be 'in arrears of subscription'. If such arrears are not paid by the last day of February following, he shall not be entitled thereafter to receive publications of the Institution as described in Regulation 67, or upon making such payment at a future date to receive the back publications for the period between the last day of February and the date of his making payment.

57. Every member on transfer to a higher class of membership shall pay, apart from the appropriate transfer fee, the full subscription for the current year appropriate to the class to which he has been transferred, and the subscription he has already paid for that year in his previous class shall be taken as in part payment thereof. If the

transfer has taken place after the last day of February, he shall, however, be required to pay only the difference between one-half the annual subscription in the higher class and one-half the annual subscription in his previous class in addition to the subscription he has already paid in the previous class.

58. All admission fees comprising entrance fees and transfer fees, and compounding fees shall be invested in accordance with Bye-law 77.

59. Any Member, Associate Member or Companion whose subscription is not in arrear in terms of Regulation 56, may compound his future subscriptions by payment of a single compounding fee depending on his age and in accordance with the table in Regulation 49. If as an Associate Member he has already paid life compounding fees, on transfer to Member, he shall be required to pay if he wishes to pay life compounding fees as Member, the difference only between the life compounding fee as Member and as Associate Member applicable to his age at the time of his transfer. If, however, he does not wish to pay life compounding fees as Member, he shall pay an annual subscription of Rs. 30.

60. The table of life compounding fees shall be liable to alteration from time to time as deemed advisable by the Council on actuarial advice, but such alterations shall not affect payments of life compounding fees already made on dates antecedent thereto.

PUBLICATIONS

61. The regular publications of the Institution shall be the *Journal*, the *Bulletin* and the *Year-Book*. The Secretary shall be the Editor of these publications, and they shall be prepared, printed and published under the order of the Council.

62. The *Journal* shall be issued in Parts corresponding to the Divisions and the Hindi Section and the frequency of issue of each Part shall be determined by the Council.

63. The *Bulletin* shall be issued every month.

64. The *Year-Book* shall be an annual publication and shall be published as soon as practicable after the last day of August in each year.

65. Each Member, Associate Member, and Graduate shall on application to the Secretary in writing receive the Part of the *Journal* pertaining to the Division to which he is attached and the Hindi Section. Further, each Member, Associate Member and Graduate shall also receive individual issues of Parts of the *Journal* pertaining to the other Divisions provided he makes an appropriate application to the Secretary in writing. Each Companion and Affiliate Member may opt for the Part of the *Journal* which he wishes to receive. Subscribers shall receive all Parts of the *Journal*.

Every member of any class shall receive the *Bulletin*. Every member of any class, with the exception of Students, shall receive the *Year-Book*.

PAPERS

66. (a) All papers and articles from members for publication in the *Journal* shall be submitted by authors direct to the Secretary, in accordance with the rules for submission of papers which may be current from time to time.

(b) The Secretary shall obtain from every person submitting a paper or article a statement that it has not been previously published in any form or manner and that he will not permit its publication elsewhere before it is accepted or declined by or withdrawn with the consent of the Institution. The paper if accepted for publication by the Institution the copyright therein shall thereupon become the property of the Institution in accordance with Bye-law 101.

(c) The Secretary as Editor of the Journal shall first examine the paper or article, and shall return it to the author if it does not comply with the rules for submission of papers, or if it is of a standard not acceptable to the Institution.

(d) The Secretary shall forward such other papers or articles as he may accept under (c) above to the Chairman of the Division concerned.

(e) The Division Chairman, acting for the Division Board, shall decide whether or not to accept the paper or article, and return it to the Secretary with his recommendations.

(f) If the paper is accepted by the Division Chairman, the Secretary shall arrange for its publication in the Part of the *Journal* concerned as early as practicable.

(g) Papers from non-members may be received by the Secretary and processed in the same manner as described in (a), (b), (c), (d) (e) and (f) above.

(h) Discussions on papers may be submitted by members and non-members to the Secretary within the time specified with the publication of each paper.

(i) Papers may be independently submitted by authors to the Local Centre and Sub-Centres. If accepted, they shall be read at a meeting of the Local Centre or Sub-Centre.

PRIZES

67. All papers and articles written by members and non-members and published in the *Journal* shall be eligible for the award of prizes, except in so far as where the conditions of award of any prize restrict it to a particular branch of engineering or a particular class of membership, when its award shall be made only subject to those conditions.

68. The award of prizes shall be made by the Council, on the recommendations of a Committee consisting of the President, the Division Chairmen, and two other persons to be co-opted by the President if necessary, except where the conditions of award of any prize include the judgment of representatives of the donors, when their recommendations shall also be taken into account.

ACCOUNTS, RECORDS AND PROPERTY

69. All moneys received by the Institution whether at the headquarters, Local Centres or Sub-Centres shall be paid as soon as possible into the accounts of the Institution with the Institution's bankers, and no part of any receipt shall be withheld from such payment into the Bank in order to meet any expenditure.

70. Every Auditor or Auditors of the Headquarters, Local Centre or Sub-Centre shall have the right of access at all times to the books and accounts of the respective offices and shall be entitled to require of the respective offices such information and explanations as he or they may think necessary for the performance of his or their duties. The Auditor or Auditors shall make a report at the time of the annual audit of the respective offices to the members on the accounts examined by him or them and state whether in his or their opinion and according to the explanations given to him or them the said accounts give a true and fair view of the state of affairs of the respective offices.

71. The minutes of all General Meetings of the Institution shall be open to any Corporate Member at all reasonable times on previous notice in writing to the Secretary. The minutes of all meetings of the Council shall be open to any member of the Council at all reasonable times. The accounts of the Institution shall be open to any member of the Finance Committee and of the Council at all reasonable times, and on previous notice in writing to the Secretary, to any Corporate Member. The accounts of a Local Centre or Sub-Centre shall be open, on previous notice in writing to the Honorary Secretary, to any Corporate Member attached to that Local Centre or Sub-Centre.

72. The Council shall afford access, subject to such reasonable restrictions as they make think proper, for any Corporate Member to the books containing the minutes of proceedings of any meeting of the Institution. No member shall have any right to inspect any Institution document, other than the books in the libraries of the Local Centres and Sub-Centres, except as conferred by this Regulation or authorised by the Council.

DIVISION BOARDS

73. Each of the Division Boards shall have such powers, duties and functions as may be defined by the Council from time to time. Its activities shall be generally directed to the advancement of the Division as specified in Bye-law 7.

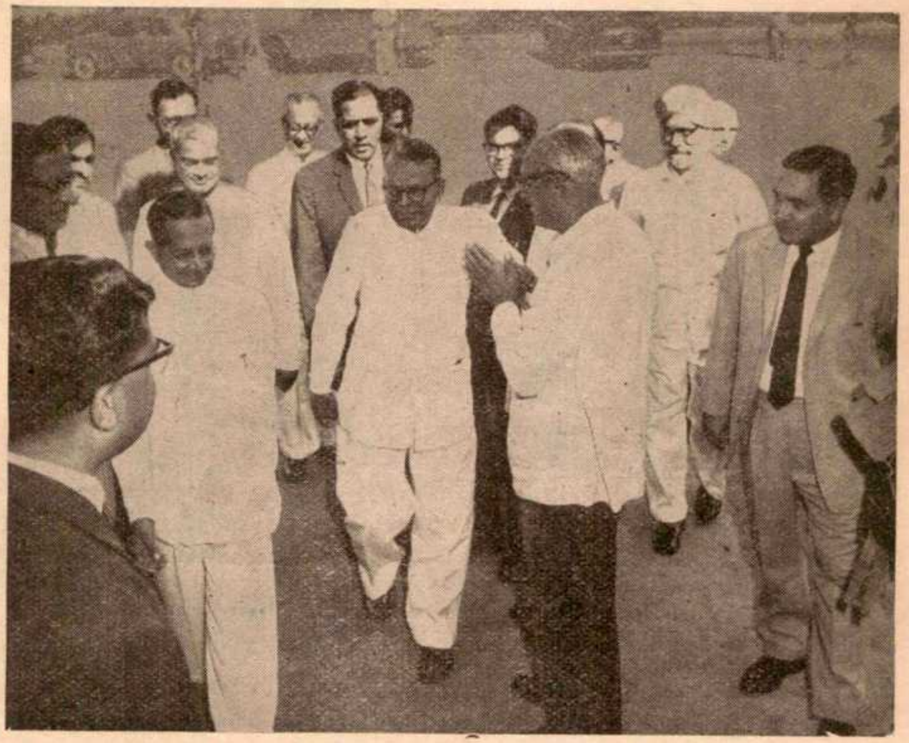
EXAMINATIONS COMMITTEE

74. The Examinations Committee constituted in accordance with Bye-law 34 shall consist of seven Members, one from each Division.

AMALGAMATION OF THE MYSORE ENGINEERS' ASSOCIATION WITH THE INSTITUTION OF ENGINEERS (INDIA), AND OPENING OF THE NEW BUILDING OF THE MYSORE CENTRE, BANGALORE, MAY 24, 1964

The amalgamation of the Mysore Engineers' Association with the Institution of Engineers (India) was celebrated and the new building of the Mysore Centre of the Institution formally opened at a function held on May 24, 1964, at Bangalore. It was held in the main hall of the new building. The new building was declared open by Dr. K. L. Rao, Honorary Life Member, Minister for Irrigation and Power, Government of India.

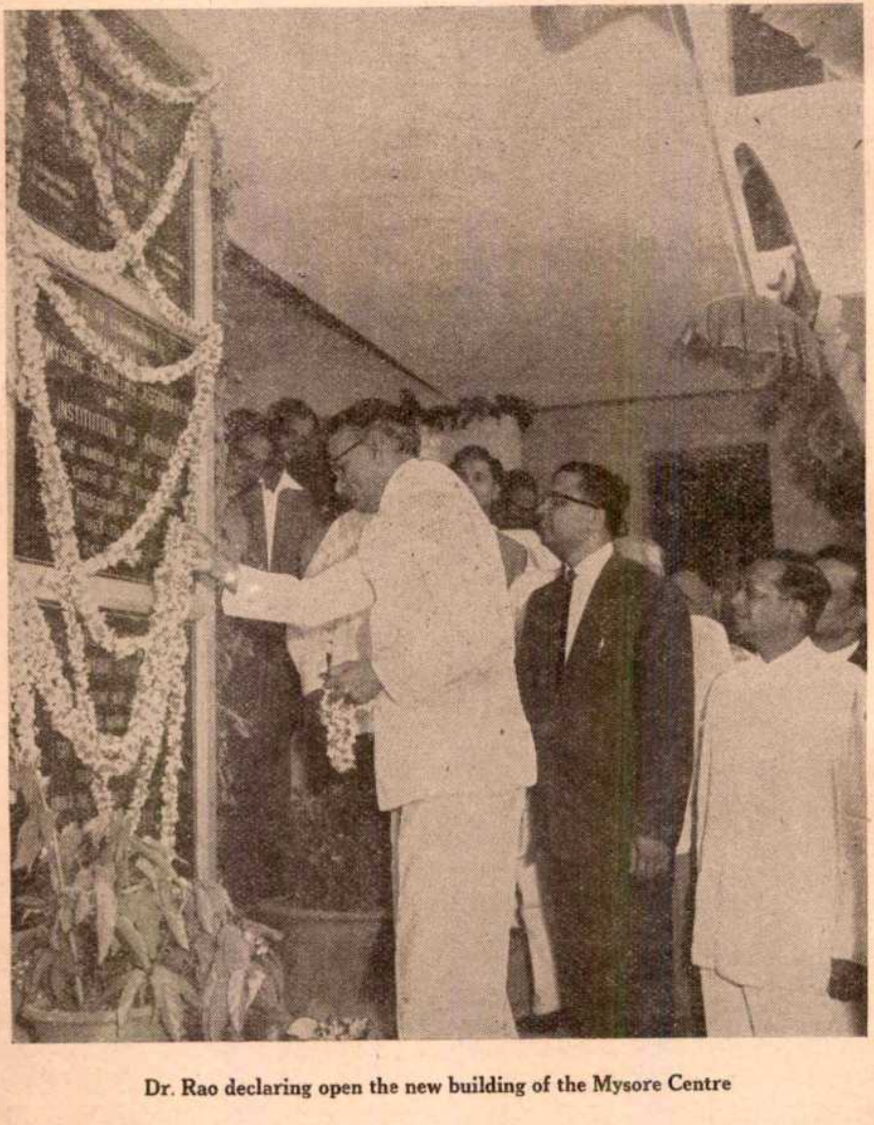
Shri M. R. Arya, M.I.E., a Past-Chairman of the Mysore Centre, welcomed Dr. Rao and the gathering in the absence of Shri B. R. Manickam, M.I.E., Chairman, who was indisposed, and also read his welcome speech. Shri G. Sambasiviah, Vice-President of the Mysore Engineers' Association, presented a Commemoration Plaque together with a Sandalwood Casket to symbolize the amalgamation of the two institutions. They were received by Shri D. P. R. Cassad, M.I.E., Past-President, on behalf of Dr. T. Sen, M.I.E., President, who could not be present at the function due to unavoidable reasons.



Dr. K. L. Rao being welcomed by Shri M. R. Arya and others on his arrival

Dr. Rao also unveiled a portrait of Shri B. R. Manickam, who was the last President of the Mysore Engineers' Association, and later addressed the gathering.

Shri S. G. Ramachandra, A.M.I.E., Joint Honorary Secretary, Mysore Centre, proposed a vote of thanks. The guests and members were entertained to a 'Tea' at the conclusion of the function in the grounds of the new building.



Dr. Rao declaring open the new building of the Mysore Centre

The Mysore Engineers' Association

The Mysore Engineers' Association, Bangalore, was started in 1863, and for a hundred years it had been rendering valuable service to the engineers of Mysore State in the promotion and spread of engineering knowledge. The Mysore Centre of the

Institution of Engineers (India) was started in 1935 and housed in the building of the Mysore Engineers' Association. This, in a measure, became a reason for the gradual decline in the technical activities of the Association. There were several moves in the past for amalgamating the Association with the Institution. As far back as 1922, even before the formation of the Mysore Centre of the Institution, the question of affiliating the Mysore Engineers' Association with the Institution was discussed. The Committee of the Mysore Centre of the Institution held on September 6, 1963, moved the Association to consider the question of this proposed amalgamation.

The Committee appointed by the Council of the Institution in October 1963 to examine the proposals for the amalgamation of the Mysore Engineers' Association with the Institution and make suitable recommendations, met in Bangalore on November 28, 1963. After detailed discussion of the recommendations received, the Council at their 434th meeting held in Hyderabad on February 11, 1964, resolved that the amalgamation of the Mysore Engineers' Association with the Institution be approved.

The following terms of the amalgamation were unanimously agreed to:

1. The present building of the Mysore Engineers' Association shall be transferred to and vested in The Institution of Engineers (India).
2. The building shall be established as a centre for engineering research within The Institution of Engineers (India) in coordination with the Government of Mysore.
3. No other assets of the Mysore Engineers' Association shall be taken over by the Institution.
4. The present members of the Mysore Engineers' Association shall be admitted into the Institution in the appropriate classes of membership within one year of the date of amalgamation.
5. Upon such admission, the entrance fee appropriate to the relevant class of membership shall be waived.
6. Upon amalgamation, the subscription of members of the Mysore Engineers' Association admitted into the Institution shall be waived for a full year, *i.e.*, they shall pay no subscription for the Institution year 1964-65.
7. Members thus admitted shall pay the annual subscriptions appropriate to the respective classes of membership thereafter.
8. Three scholarships, each worth Rs. 900 per annum, shall be established in the name of the Mysore Engineers' Association for award to outstanding students studying in engineering colleges affiliated to the Mysore University. These scholarships shall be permanently established by the Institution in the Public Charitable Trust for the Advancement of Engineering Education, which is being operated by the Institution. The award of the scholarships shall be decided by the Mysore Centre, and the Mysore Centre shall frame rules for their award.
9. A Lecture to be styled 'The Mysore Engineers' Association Centenary Lecture' shall be established by the Institution and delivered annually at

the Mysore Centre by an eminent person. An honorarium of Rs. 1,000 shall be provided by the Institution for this purpose.

10. All the present activities of the Mysore Engineers' Association consistent with the aims and objects of the Institution shall be continued, and the name of the Association and its past office bearers shall be suitably commemorated.

11. The members of the present Executive Committee of the Mysore Engineers' Association shall be ex-officio members of the Committee of the Mysore Centre for one year from the date of amalgamation.

Welcome speech by Shri B. R. Manickam, M.I.E., Chairman, Mysore Centre*

'It gives me great pleasure to welcome you all to this function, which we were eagerly waiting for. It is a function to symbolize the amalgamation of the Mysore Engineers' Association with the Mysore Centre of the Institution of Engineers (India), and this opportunity has also been availed of to get the new building of the Mysore Centre formally declared open by our Minister for Irrigation and Power, Dr. K. L. Rao.

It is very kind of Dr. Rao to have accepted our invitation to declare open this building. We know that he is very busy with the various problems of irrigation and power in the country. In fact, the circumstances were such that at one time we were afraid that he would not be able to perform this function on account of the heavy work schedule he had to fulfil. We are grateful to him for having adjusted his programme to be here with us and bless the amalgamation of the two institutions.

I need not dwell on the greatness of Dr. Rao as an eminent engineer and now as a statesman. Dr. Rao is a Past-President and a Honorary Life Member of our Institution and one day he will be remembered as an engineer-statesman like Sir M. Visvesvaraya. On behalf of the Institution and on behalf of the Mysore Engineers' Association, I extend a hearty welcome to Dr. Rao.

During the Centenary Celebrations of the Mysore Engineers' Association, a Souvenir was issued where the history of the Mysore Engineers' Association and its activities for a hundred years, from 1863 to 1963, have been described. The Mysore Engineers' Association was started as a part of the activities of the Public Works Department, Government of Mysore, by the late Col. Lewford in 1863, and developed into an institution of engineering activities which included publication of technical bulletins and dissemination of information on engineering works, particularly of the Mysore State. Many Chief Engineers and other eminent engineers of Mysore held office as Presidents of this Association. It had thus an originality of its own and being a much older institution than our own, its members were not in readiness to easily agree to this merger with the Institution of Engineers (India), which was founded as late as 1920. When Dr. Rao was the President of the Institution, he had advised the members of the Association that it would not be worthwhile running two parellel institutions for the same purpose, and further, with the construction of a separate building for the Mysore Centre, the services that the two institutions were rendering in conjunction under one roof for the benefit of the engineers in the profession and engineering students could not be continued as effictively as it had been any more. Again, the Library and Reading Room facilities that were available in the Association building where the Association and the Institution's Local Centre had functioned thus far, had to be bifurcated with the Local Centre's own building coming into being. It was then found that it would be more economical to pool up the resources of both the institutions, and hence a decision was taken that amalgamation of the two should take place.

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* In the absence of Shri Manickam who had taken suddenly ill in the morning, the speech was read by Shri M. R. Arya.

The proposal for amalgamation was approved by the General Body of the Mysore Engineers' Association on November 3, 1963. The Corporate Members of the Institution of Engineers (India) endorsed the decision of the Council approving the terms of amalgamation on February 11, 1964, at their 44th Annual General Meeting held at Hyderabad. The main terms of the amalgamation comprised :

(1) Admission of members of the Mysore Engineers' Association as Corporate Members of the Institution of Engineers (India) in the appropriate classes of membership, with exemption of entrance fee and with the concession of free membership for one year ;

(2) Establishment of three scholarships each worth Rs. 900 per annum in the name of the Mysore Engineers' Association for being awarded to outstanding students studying in engineering colleges affiliated to the University of Mysore ;

(3) Establishment of a lecture to be styled 'The Mysore Engineers' Association Centenary Lecture' by the Institution of Engineers (India), to be delivered annually at the Mysore Centre by an eminent engineer to whom an honorarium of Rs. 1,000 is to be provided by the Institution ; and

(4) The establishment of an engineering research centre in the building of the Mysore Engineers' Association.

The merger of the two institutions we were awaiting for has now taken place, and with this, the membership strength of the Mysore Centre will be nearly 3,000 including Graduates and Students, the number of Corporate Members being 670. The combined Library has now a total of 4,000 books.

The new building of this Local Centre which has cost nearly Rs. 4,00,000 and was formally declared open by Dr. Rao earlier this afternoon has been built on a site granted to the Institution by the Government of Mysore. The Government gave, in addition, a munificent donation of Rs. 1,00,000 for the building. The Institution financed the building to the extent of Rs. 95,000. The Local Centre has been able to raise funds to the extent of Rs. 1,35,000 and needs a further sum of Rs. 70,000 for completing the building in all respects including modern treatment to this auditorium where we have gathered. The convenient location of the building has made it a venue for functions in the city. Apart from the meetings of our Institution, many important management, technical, educational, scientific and cultural organizations in Bangalore and the University of Mysore, have already begun to make use of this auditorium for their meetings, seminars and conferences. Thus a medium sized, centrally located hall to accommodate nearly 350 persons is now available in the city.

With these words, I extend to you all, particularly to those who have come from far-off places to attend the various meetings of the Institution, a cordial welcome. I hope their stay in Bangalore has been comfortable and enjoyable, and request them kindly to bear with us for any shortcomings.

I like to mention that due to an unavoidable engagement, our President, Dr. Sen, had to leave this place this morning for Calcutta. He was to have attended this function and received the Commemoration Plaque and the Casket from the Mysore Engineers' Association. In his absence, Shri D. P. R. Cassad, a Past-President of the Institution has kindly agreed to receive them on Dr. Sen's behalf.

I now request Shri Sambasiviah, Vice-President of the Mysore Engineers' Association, to formally annouce the amalgamation and present the Commemoration Plaque and the Casket to the Institution.

Thank you'.

Speech by Shri G. Sambasiviah, Vice-President, Mysore Engineers' Association, presenting the Commemoration Plaque and Casket

'I have a very pleasant duty to perform, that of presenting the Commemoration Plaque and Casket to Shri D. P. R. Cassad, Past-President of the Institution, as a memento to signify the amalgamation of the Mysore Engineers' Association with the Institution of Engineers (India).

You are all perhaps aware that the Mysore Engineers' Association celebrated its Centenary only a few months ago under the august presence of His Highness Shri Jayachamaraja Wadiyar, the then Governor of Mysore. During the hundred years since its inception, the Mysore Engineers' Association has rendered yeomen service in the field of engineering, and I think this is the oldest engineering association in the country.

I now request Shri Cassad kindly to accept the Commemoration Plaque and Casket on behalf of the Institution.'

Reply of Shri D. P. R. Cassad Past-President, accepting the Commemoration Plaque and Casket

'It has given me much pleasure to be present here on this auspicious day which has witnessed the merger of the century-old Mysore Engineers' Association with the comparatively younger institution, the Institution of Engineers (India), the only Chartered Institution in the country, established in 1920. It is with great joy that I accept the Commemoration Plaque and Casket which signify a great event, on behalf of Dr. T. Sen, President of the Institution of Engineers (India), who, due to unavoidable reasons, could not stay over to be present on this occasion. I convey my sincere apologies on his behalf for his absence.

This Plaque and Casket which will remain with the Mysore Centre will serve to remind us all of the great part played by the Mysore Engineers' Association during an eventful epoch lasting a full century—a part well and rightly played for the development of the State, particularly in the field of engineering, including engineering education and research.

Shri D. P. R. Cassad receiving the Commemoration Plaque and Casket

The Mysore Engineers' Association was founded by the late Col. Lewford in 1863. In the beginning, it was conceived to be a part of the activities of the Chief Engineer and the Public Works Department of the State, and had on its roll 44 engineer-members. It has amongst its Past-Presidents such great names as Sir M. Visvesvaraya, Shri K. Srinivasa Rao, Shri K. Krishna Iyengar, Dewan Bahadur N. N. Iyengar, Shri B. S. Narsinga Rao, and last but not least, Shri B. R. Manickam, who has served as its President from 1959 to 1964 and is its last President, and due to whose efforts this merger has come to take place. This integration of the two institutions, it is needless to add, justly symbolizes the solidarity and unity that exists amongst the fraternity of engineers in the country. This aspect assumes greater importance when we give a thought to the herculean tasks that are ahead of the engineers in implementing the Five Year Plans in which the country is engaged.

The engineers in the country and the members of the Institution have played their part well, but as the country is emerging from one Plan and entering another, the responsibilities of the engineers have been increasing multifold ; and it is for us, the engineers, to justify the confidence placed in us by strictly observing the codes of our profession and adhering to high professional standards in our assignments. It is a happy augury that our engineers are in the fore of the country's affairs. One of our Past-Presidents, Dr. Khosla, formerly a Member of the Planning Commission, Government of India, and now Governor of Orissa, is playing a very laudable part in the development of the Orissa State ; and Dr. K. L. Rao, another Past-President and now Minister for Irrigation and Power in the Union Cabinet, has taken to his tasks in a very workmanlike manner. We are honoured that these two stalwarts are paving the way for more and more engineers to take part in the development of the country.

As a Past-President of the Institution, I congratulate the Mysore Engineers' Association and the Institution for the bold step they have taken in bringing themselves together, and I thank Shri Manickam whose hard work has brought about this significant event. The main terms under which the amalgamation has come to be effected, as already explained by Shri Manickam, are :

(i) Establishment of three scholarships of Rs. 900 each per annum for outstanding students in engineering colleges of the Mysore University by the Institution under the Public Charitable Trust of the Institution which emanated as an outcome of the pioneering spirit of Dr. Rao.

(ii) Use of the Mysore Engineers' Association building for the establishment of an engineering research centre.

(iii) Establishment of a lecture to be styled the Mysore Engineers' Association Centenary Lecture to be delivered annually by an eminent person.

(iv) Absorption of members of the Mysore Engineers' Association into the proper grades of membership in the Institution to which they are qualified.

This happy union will also strengthen the Mysore Centre by increased membership on its roll and benefit its Library with a large addition of books on technical subjects.

This merger has pointed out that in union lies our strength and in integration lies the salvation of our country.

I again thank the Mysore Engineers' Association and the Institution for providing me an opportunity to be present and express myself on this significant occasion'.

Speech by Dr. K. L. Rao, Minister for Irrigation and Power, Government of India

Dr. Rao who presided over the function, unveiled a portrait of Shri B. R. Manickam, Chairman of the Mysore Centre of the Institution, who held office as the last President of the Mysore Engineers' Association, and spoke of the selfless service he had given in building up the engineers' stature in the State of Mysore.

Dr. Rao unveiling the portrait of Shri B. R. Manickam

Speaking on the occasion, he said that the most urgent problem before the country was the dearth of power and appealed for vigorous efforts from all those concerned on the power front so that the output could be substantially increased and the various problems tending to halt the progress of power development in the country could be solved.

The installed capacity, he continued, was only about 7.5 million kW, while it should have been four or five times as much. He also spoke of a variety of difficulties such as dependence on foreign imports, the resulting delays, etc. coming in the way of progress ; and pointed out that time had come for a positive step in regard to handling of works requiring consultation, designing, erection, etc. in the field of power generation.

Referring to the problems connected with the distribution of power, Dr. Rao said that the existence of very small distributors of power (presumably in the private sector) had become obsolete in the context of grids and supergrids. The performance of some of such distributors was not very happy, he remarked.

He further indicated that he had proposed the investigation of the tributaries in the Ganga basin and the possibilities of power generation in order to improve the power position in Uttar Pradesh. Pointing to the relationship between electricity and economic development, Dr. Rao called upon the Institution to go to the assistance of the Centre in tackling the various problems connected with the generation and distribution of power in the country. He promised assistance to the engineers and their institutions engaging themselves in that task.

He stressed that the Institution could study the several aspects of this problem and indicate to the Government what steps should be taken to minimize delays in the execution of power projects. He pointed out that members of the Institution could organize study groups to discuss the problems, and advise the Government in regard to designing, erection and transmission jobs. He referred to the proposed Southern Power Zonal Grid with its headquarters in Bangalore, which he called 'the home of electricity'. Referring to controversies over utilization of waters of inter-State rivers, he said that given the spirit of integration and national unity, acceptable solutions could be found for 'delicate and difficult problems'.

Dr. Rao addressing the gathering

Dr. Rao also spoke of the need for honesty and integrity in the nation's life. Referring to the problem of corruption, he commended the efforts of the Union Home Minister, Shri Gulzarilal Nanda, in tackling it. He also appealed for cooperation from the Institution in this connection.

He paid tributes to the pioneering efforts made in Mysore in the field of hydroelectric power generation and to the electrical engineers of Mysore for their contributions. Referring to the facilities existing in Bangalore, he said the city had the necessary atmosphere for furthering work in regard to power development, and added that Bangalore had been rightly made the headquarters of the Southern Zonal Power Grid.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETING OF THE LOCAL CENTRES

Rajasthan Centre

Chairman's address by Shri B. D. Mathur, M.I.E., at the 5th Annual General Meeting of the Centre on February 1, 1964.

After welcoming the Chief Guest, Shri Mohan Lal Sukhdia, Chief Minister, Rajasthan, and other invitees, Shri Mathur thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering the Chairman's address, he said, 'In any developing economy, engineers are always called upon to play an important role. Out of a total outlay of Rs. 4,600 crores in the public sector during the Second Five Year Plan, construction activity accounted for about Rs. 2,000 crores, of which Rs. 800 crores were spent upon buildings alone. In the Third Five Year Plan which envisages a total investment of Rs. 10,400 crores both in the private and public sectors, the figure of expenditure for construction activities and for buildings would be correspondingly more. Even if we can achieve a 5% saving in the construction activities, the saving will be of the order of Rs. 150 crores, which can roughly pay for an additional steel plant. Realizing the importance of such a saving, a 'Construction Economy Cell' has been set up in the Planning Commission, Government of India. But this alone will not help, and an overall effort is required to be made by everyone in the profession to achieve the maximum possible economy.

Cost reduction should not be linked with the lowering of specifications, but should be achieved by a detailed and scientific study of all the factors that go to make up the total cost of the work. During the planning stage, a detailed study should be made for assessing the requirements. For this, the various norms fixed by the National Buildings Organization should be adhered to. In detailed planning, effort should be made to make the best use of the available materials and resources after considering the various alternatives. To achieve maximum efficiency during construction, detailed material budgeting and labour planning are essential. Delays in actual construction which lead to reduced production and frustration in the minds of the public should be avoided by proper site planning, site organization and programming of work.

We, in India, are spending lage amounts of money for the development of our National Laboratories such as the Central Road Research Institute and the Central Building Research Institute, but so far, modern research in construction practices and designs has not made sufficient impact on the construction methods and practices obtaining in the country. The main difficulty in the implementation of the results of research is the lack of testing facilities in the States. Some of the engineers, not having been given training in the new sciences such as soil mechanics, prestressed concrete, etc., hesitate, to use the specifications on their own initiative. They are kept tied down to busy office schedule arising out of high work load, and seldom find time to venture into the new. Some of the progressive States in the country have become alive to this and have set up excellent testing and research laboratories in their Public Works Department. We have also made a beginning by setting up a small testing laboratory at Jaipur. In road construction, we are at present engaged on the construction of experimental roads based on techniques evolved by the Central Road Research Institute at four places. Work is already in progress on the construction of five miles length of road in Ganganagar District using Mehra's method, and near Jaipur on the Kishengarh-Renwal road, the conventional soling stone base course is being replaced by stabilised soil. In the next few months, we hope to take up the construction of an experimental stretch of road in Nagpur District wherein locally available soil and gravel will be blended and used for the base and wearing courses. In the Kotah area, it is proposed to lay lime-stabilized black cotton soil as a sub-base for the costruction of a road from Leban to Leban railway station. This would improve the riding qualities of the road surface and also effect economy in maintenance. The pace of such works has, however, been slow but we hope to accelerate it and maintain steady progress, so that the State can benefit by the construction of greater lengths of roads within the extremely poor fund allotment placed at our disposal for highway construction. It is hoped that our Local Centre would become a forum for discussion and dissemination of information of all the new techniques used for reducing the costs of construction.

Cost reduction schemes in construction agencies are essentially linked with the administration of the Public Works Department. The department as constituted now was evolved during the pre-independence days for the up-keep and maintenance of public works. The work load which was then low has now considerably increased and the department has to bear the full responsibility of all the construction works arising due to the all-round development activities. In our State, the work load of the Public Works Department (Buildings and Roads Branch) during the last decade has now increased four fold as compared with that in the year 1950-51. The increase in staff during the corresponding period has, however, been only about double. This increase of work load per working division casts a heavy burden on the engineering personnel who get bogged down in paper and ordinary routine work and can find no time to plan for the efficient and speedy execution of works, which are the prerequisites to any cost reduction scheme. It is, therefore, imperative that while considering the staffing pattern of the departments emphasis should be given to the manner in which the department is organised rather than on the work load alone. Many of the progressive States have set up 'design cells' or 'design directorates' under a superintending engineer to take up the overall charge of designs of major works. This pooling of the design staff at one place would result in elimination of delays and in considerable saving in the cost of construction which would be many time as compared with the expenditure needed on the staff. The Planning Commission constituted a Panel under the auspices of the Building Projects Team, and the Panel's report has been sent to the States and the Central Government for consideration. The Panel has recommended :

(a) Changes in procedure for speeding up progress of works;

(b) Modifications of the conditions of contract ;

(c) Enhancement of the financial powers of executive engineers and superintending engineers in respect of technical sanction of works and acceptance of contracts ;

(d) Creation of work study cells in construction agencies;

(e) That the Department of Finance must appreciate that the techniques have advanced so rapidly and are so complex that staff requirements have increased and also that under-staffing often results in higher costs ;

(f) Changes in the administrative set-up for the purpose of effectively coordinating the technical activities in the State with a view to maximization of resources and reduction in cost and for effecting unitary control over the public works administration ; and

(g) Creation of a Board of Chief Engineers.

The implementation of these recommendations by the Government will, it is expected, go a long way towards expeditious execution and economic and efficient management of engineering works.

It is a matter of considerable satisfaction that the All-India Service of Engineers has been constituted by an Act of Parliament. We earnestly hope that the formation of the service will not be delayed any further. Whereas in other advanced countries technical personnel are not only paid adequately but are paid better than the non-technical personnel, it is a pity that in our own country their emoluments have been fixed at a lower level, specially in Rajasthan. Even the pay scales proposed for the Indian Service of Engineers are comparatively less than the pay scales of the Administrative and Police Services. The Engineering Service should also be given proper attention. I would also desire the formation of an All-India Service of Public Health Engineers.

The country as a whole, the Rajasthan State in particular, has made rapid progress in the development of technical education during the past decade. Besides increasing the intake at the engineering colleges at Jodhpur and Pilani, a new regional engineering college with an intake of 250 students is being set up in Jaipur. The growth of technical education is an index of the economic growth of the country, but we must guard against the possibility of deterioration of the quality of technical personnel and provide for full employment. The need for engineering personnel by the Public Works Department and other government undertakings is limited by the quantum of public investment. In order to create employment potential, it must be made obligatory for other agencies in the different fields of construction and industry to employ engineers of the requisite qualification for the preparation of schemes and their execution thereof.

At present, engineers in Public Works Departments have no system of post-selection pre-service training, which is considered essential the world over. Detailed recommendations for such in-service training, which we had made to the 'State Committee on Training', have been largely accepted. We hope that the Government would now agree to the creation of training cadres in all technical departments so that these recommendations can be implemented. For making the best use of the available resources, it is necessary that all the posts in the department should be manned by persons suitably qualified and properly trained to shoulder the duties assigned to them.

The increased tempo of construction activity during the Five Year Plans has put a great strain on the available skilled manpower in our country. The new generation of workers get little or no training and this has a direct bearing on the quality and standard of production, resulting in higher costs. It has, therefore, become necessary to have a greater number of vocational training institutions for imparting training to artisans and craftsmen.

In the past, roads were constructed to carry only the limited passenger or goods traffic that originated. The phenomenal increase of traffic as well as the trends towards bigger and heavier transport vehicles demand better roads, properly designed, keeping in view the soil conditions, the traffic needs and the topography. Scientific design of road pavement to stand up to these needs will necessitate an increase in the original cost of road construction. The funds made available to us in the Third Five Year Plan have, on the other hand, decreased to 5% of the Rajasthan State Plan as against 10% in the case of the Second Plan. This shortage of funds and the natural desire to construct the maximum possible lengths of road, have driven us to construct our highways to sub-standard specifications, which will ultimately result in a high overall construction cost if considered over a 20-year period. This trend can be checked only by giving higher priority to roads and road transport in the future Five Year Plans. The total length of surfaced and unsurfaced roads maintained by the P.W.D. in Rajasthan at the end of the Second Five Year Plan was 8,263 miles and 8,461 miles respectively, which gives a mileage of 12.69 per 100 sq. miles of area, as against an all-India average of 26 miles. On the basis of the 'Twenty Year Road Development Plan' framed by the Chief Engineers of India, the total outlay on new construction and improvement of roads for Rajasthan works out to Rs. 43 crores for the Third Plan period. As against this, the actual outlay is expected to be only about Rs. 9 crores. The gravity of the situation in Rajasthan can be gauged from the fact that while the Government of India have allotted Rs. 438 crores for the Third Plan under the Roads Sector as against a demand of Rs. 590 crores calculated on the basis of the Twenty Year Road Development Plan, which is almost 75% of the demand, the allotment in Rajasthan works out to 21% only. Because of the meagre allocation of funds and the low priority given to road development, the gap in Rajasthan compared with the all-India Average would widen further.

With a view to promote the coordinated development of roads and road transportation to cater to the needs of the country's economy effectively and in order that roads may receive a fair deal, the Indian Road Congress has repeatedly been stressing the need for the constitution of 'Road Boards' both at the Centre and in the States. The functions of the State Road Boards should comprise :

1. Laying out a policy, and direction and control of construction and maintenance of all roads other than National Highways and strategic roads ;
2. Control of traffic on such roads ;
3. Coordination of plans for road development and proposals for allocation of funds ;

4. Enunciation of the principles of taxation on road transport for financing the development and maintenance of roads ;
5. Laying out a policy regarding priorities, allocation of funds, and specifications ; and
6. Promotion of road and transport research and arrangements for training personnel for construction of roads and operation of road transport.

This recommendation of the Indian Roads Congress is at present under the consideration of the Central and State Governments and the acceptance of this would help in a coordinated growth of roads and road transport.'

Summaries of Papers Published in the Journal, vol. 44, no. 9, pts. EL 5, CH 3 and PH 3, June 1964

ELECTRICAL ENGINEERING DIVISION

Measurement of Efficiency of large Water Wheel Generating Units

P. Achyutham
Associate Member

The measurement of efficiency of large water wheel generating sets which are being installed in the large hydroelectric projects in India, has posed a difficult problem so far. In this paper, a method for the measurement of efficiency of a large water wheel generating sets by means of the Gibson test apparatus is described. The need for indigenous production of such a test apparatus is also indicated.

Application of Monte Carlo Method for the Solution of a D.C. Network from Node Equations

Dr. S. Das Gupta
Associate Member
and
A. K. Roy
Non-member

In steady state analysis of D.C. networks, the method used is to invert the pertinent conductance matrix and obtain the node pair potentials. In this paper, a statistical method of obtaining the nodal solution of a D.C. network is described. A network is actually solved up to the inversion of the conductance matrix for an assumed reference frame. The results are further improved by two iterations according to Newton's method and compared at each stage with the actual values (correct to four places of decimals). Curves showing the approximate rate of change of inverted elements at an interval of ten games are given.

Characteristics of Composite Dielectrics

Dr. L. M. Hore

Associate Member

Electrical parameters, *viz.*, permittivity, tg δ of a combination of dielectrics, radically differ from those of the individual dielectric; and even with the same combination, the characteristics have been observed to change when the thickness of the individual dielectric alters. The theory established here in the light of the Russian scientist Skanavy's findings is seen to tally in most cases with experimental observations.

Study of System Stability in a Model Power System

M. Seshaphani

Non-member

and

R. C. Pal

Associate Member

This paper deals with the study of system stability using a model power system. It discusses the feasibility of using the model power system to study the stability of an actual system. Some of the methods of improving the stability are described, and the effect of series-capacitor method on the stability of the model power system is explained. Some experimental results are also given.

Generalization of Scott and Open Delta Connections

Dr. V. S. Subba Rao

Associate Member

A method of transforming unbalanced two-phase voltages into balanced three-phase voltages by means of two suitable static transformers has been discussed. Scott and open delta connections can be considered to be special cases of this general method. The necessary equations for current transformation are also obtained. It is shown that the instantaneous power supplied from the two-phase side remains constant, as it should for successful transformation. The complete vector diagram is also given.

CHEMICAL ENGINEERING DIVISION

Engineering Design Aspects of Rourkela Fertilizer Project

A. P. Rao

Associate Member

The Rourkela Fertilizer Project, with an estimated cost of about Rs. 20 crores, is one of the major industrial projects of the Second Five Year Plan, which will help to boost up the production of fertilizers in India, thus enabling greater food production in the country. This article describes in brief the engineering design aspects of the processing of ammonia to nitric acid and ammonium nitrate and the production of nitrolimestone fertilizer. A brief note regarding the process is also added.

PUBLIC HEALTH ENGINEERING DIVISION

Development and Use of Water Resources

Dr. B. V. Bhoota
Member
and
T. R. Krishna Rao
Non-member

Water, in addition to being necessary for human existence, is perhaps the most important single element necessary for the advancement of the society. It is used for agriculture, for drinking, for industry, for power generation, for moving cargo, for carrying wastes, and for almost every activity in which people are engaged. Civilizations in the past have developed where water was available, and it is believed that many civilizations have been destroyed due to the abuse of water resources. Being a common element, and apparently in abundant supply, water and water resources have seldom been given the importance they deserve. However, more and more nations, particularly nations which have made considerable progress, are becoming increasingly aware that the water resources of a country are limited and that an intelligent and wise utilization of these limited resources is basic to the welfare of its people. Therefore, the more enlightened nations of the world have taken steps to conserve and utilize their water resources. In this paper, the aspects of development and consumption of water resources are stressed.

Research Studies on Domestic Refuse

Dr. G. Ghosh
Non-member
A. K. Adhya
Non-member
and
I. Radhakrishnan
Non-member

The role of domestic refuse in the spreading of epidemics in a congested city is well known. The problem of a suitable disposal of domestic refuse, which has been enhanced by population growth, needs thorough analysis, both physical and chemical. In this paper, the results of the authors' research on domestic refuse in the Calcutta region are given.

Effect of Temperature on Sewage Treatment

S. R. Kshirsagar
Associate Member

Like many other factors, temperature has considerable influence on the sewage treatment processes. Unfortunately, except for the digestion of the sewage sludge, the treatment process not being given any more attention and the treatment plants gets designed and constructed on the basis of the flow rates of the incoming sewage and its strength alone. In this paper, the author points out how and to what extent the temperature affects the treatment of sewage and how it can be accounted for in the design of the treatment plants for use in countries with climatic conditions like India.

Water Conservation by Retarding Evaporation

R. S. Mehta
Member

and

J. S. Jain
Non-member

Growing demand for water is claiming attention of engineers dealing with water supply problems the world over to find ways and means for conserving water. The enormous quantities of pure water lost by way of evaporation annually, if controlled completely or partially, will add to the water conservation efforts. The paper deals with a recently developed technique of suppressing evaporation loss from large water bodies by the application of a monomolecular film of certain chemicals. The work done in other countries in this field is reviewed and a special reference to the work done in India is made. The salient features of the procedure to be adopted in field trials are indicated. Further data are given from the authors' experiences during their field experiments on evaporation control in this country.

INSTITUTION NOTICES

Application forms for Sections A and B of the Associate Membership Examination to be held in November 1964

Application forms for Sections A and B of the Associate Membership Examination (existing scheme) to be held in November 1964 are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions are also attached with the application forms, and they may be detached for reference, if so desired. All these forms, the programme of examinations and the detailed instructions are printed on white paper **(in black ink)** to distinguish them from those applicable to the new scheme which are printed on white paper (in red ink). Students are notified that no further application forms will be distributed to them.

Application forms for Sections A and B of the Associate Membership Examination (New Scheme) to be held in November 1964

Application forms for Sections A and B of the Associate Membership Examination (new scheme) to be held in November 1964 printed on white paper **(in red ink)** are attached to this issue of the *Bulletin*. The programme of the examinations and the detailed instructions printed on white paper **(in red ink)** are also attached with the application forms and they may be detached for reference, if so desired. Students are notified that no further application forms will be distributed to them.

Applications complete in all respects and accompanied by examination fees for admission to the November 1964 examinations and one copy of passport size photograph pasted in the space provided on the application form should reach the Head Office before 4.00 p.m. on Tuesday, September 15, 1964.

Suggested Readings for the Section A and B of the Associate Membership Examination of the Institution

The titles of books suggested for reading by candidates desiring to take up the Associate Membership Examinations of the Institution are now given in Appendix VII of the 'Rules of Syllabuses of Studentship and Associate Membership Examinations' (latest reprint, June 1964).

Extra copies of reprint of Appendix VII have been sent to all Local Centres to be available for use by Students. Students who wish to know the books suggested should contact the Honorary Secretary of their Local Centre directly.

Misdemeanour in the Institution Examinations

The Council have decided to cancel the results of the following candidates for the November 1963 examinations and debar them from appearing in the three immediately following examinations, *i.e.*, up to and including May 1965 examinations, for misdemeanour in the aforesaid examinations.

Studentship No.	Roll No.	Name
S 37816	2142 NA	Resham Singh Gulahti
S 44249	6109 A	Amarjit Singh Sodhi
S 44928	6020 A	Som Nath Chitkana
S 46361	2199 NA	Raj Kumar Jain
S 46555	2264 NA	Om Prakash Mehta

NAMES OF SUCCESSFUL CANDIDATES IN THE STUDENTSHIP AND ASSOCIATE MEMBERSHIP EXAMINATIONS HELD IN NOVEMBER 1963

The following candidates have been declared to have passed the Studentship and Associate Membership Examinations held in November 1963.

STUDENTSHIP EXAMINATION

Roll No.	Name of candidate
St. 20	K. R. Raghunathan
St. 30	Koduru Jahanm Ana Rao
St. 47	K. A. Sudhakara
St. 59	N. C. Rao Givinda Rao
St. 75	D. K. Venkateswaran
St. 88	Raj Kumar Sharma
St. 90	D. Y. Kulkarni
St. 125	Puthillath Ashokan Menon
St. 133	Ivan Patrick De Souza
St. 137	Chandrakant Harihar Pande
St. 155	J. N. Manaharanani
St. 195	Narayan Manjayya Naik
St. 196	Chacko Varghese George
St. 198	Pritam Lal Kukreja
St. 199	P. K. Athavale
St. 205	Gurappa Mallappa Kasturi
St. 207	Ivo Mario Dlima
St. 213	P. S. Asokan
St. 218	Stanley D. Costa
St. 220	Sajjad Tayebbhai Rangwala
St. 268	Sunil Krishan Mitra
St. 285	Suresh Chand Jain
St. 302	Raghunath Iyengar
St. 327	Ramesh Chander Purohit
St. 334	Nand Kishore Upadhyay
St. 342	Surjit Singh Sachdeva
St. 352	Thykkil Sreedharan
St. 374	Ved Parkash Suri
St. 377	Vishashar Singh Gupta
St. 387	Mohan Singh
St. 393	Sakti Pada Sengupta
St. 411	M. M. Usman Ansari
St. 424	Mir Khader Ali
St. 471	Jagjit Singh Thukral
St. 475	Ramji Lal Gupta
St. 486	Pritam Singh
St. 500	Bhawani Lal Mathur
St. 533	Yamini Kanta Gogoi
St. 540	Ramalingam Sakkaraiappan
St. 541	T. E. Krishnaswamy
St. 544	T. P. Premsekar
St. 554	V. K. Jayaraman
St. 560	Viswanath Subra Mani
St. 563	R. Seshadri
St. 570	G. R. Padmanabhan
St. 581	H. Chidambara Nathan
St. 582	Ch. V. Balakesary
St. 587	Hirdey Nath Dhar
St. 592	R. Muthukrishnan
St. 602	Govindarajulu Dasarathan
St. 620	Satyanarayana Munagala
St. 630	Vasudev Krishna Rao
St. 632	A. J. Devachandra Doss
St 653	V. Balakrishnan
St. 675	Asirvathan Nadar Selvaraj
St. 685	N. Ramana Gopalan
St. 695	C. M. George
St. 701	Balasubramanium Mohandoss
St. 705	Kasthuri Srinivasan
St. 706	Josyula Buddha Taraknath
St. 710	Darius Minoo Belgamvala
St. 714	Krishnier Moorthy
St. 715	J. D. Jayaraj Robert
St. 716	M. K. Subramanian
St. 718	R. Krishnamoorthy
St. 722	Chungath Thambi Simon
St. 724	S. S. Yegnanarayanan
St. 735	S. Krishnaswamy
St. 737	A. Yesudian
St. 744	T. B. Velayudham
St. 745	Puthenvettil Vasudevan
St. 746	Siddanakare Vishnu Bhat
St. 765	Rajinder Singh Baweja
St. 770	Sukhdev Lal Ohri
St. 793	Madan Lal Arora
St. 825	Manohar Singh
St. 846	Arup Kumar Banerjee

STUDENTSHIP EXAMINATION (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
St. 879	D. R. Mehta	St. 907	N. Gopalakrihnan Nair
St. 883	Kewal Krishan Chadda	St. 914	P. T. Jacob
St. 891	Thaikattil Mathew Johny	St. 950	V. Varadarajan
St. 902	C. V. Benjamin	St. 953	N. K. George

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A
(Existing Scheme)

Roll No.	Name of candidate	Roll No.	Name of candidate
3A	Narain Das Tandon	184A	K. R. Adinarayana
6A	Daivendar Kumar Sud	185A	A. B. Prahlad
7A	Anant Kumar Sud	194A	H. K. Ramamurthy
9A	Jayantilal P. Bhagdev	195A	N. Narakesari
16A	Nagindas Dhanjibhai Sheth	206A	M. S. Nagaraja
21A	J. D. Khatri	207A	B. K. Ramachandra Rao
40A	Narayan Velshi Chauhan	214A	B. S. Narasimhan
50A	Rajnikant Manilal Shah	227A	C. R. Janmane
56A	Babulal Karsandas Mistry	231A	H. S. Ramaprasad
63A	Jaswantlal Premchand Shah	232A	O. P. Ravindran
79A	Dinubhai Chimanbhai Patel	236A	A. Gopinath
87A	C C. Parikh	238A	M. S. K. Shankar
88A	Girish Chandulal Shah	243A	Jacob Mammen
96A	J. K. Ramaniklal Soni	244A	Mohan Singh Panesar
106A	Dundappa Bhimappa Giraddi	263A	Udheswar Dalbehera
115A	Kalathur Rajendra Mohan	266A	V. K. Sundara Raju
124A	H. G. Vijayendra	271A	R. Venkata Rao
128A	B. N. Seshadri	274A	S. Subbarayan
129A	P. Mallappa	280A	H. R. Iyer
132A	M. Ganganna	282A	S. Padmanabhan
133A	Devalapura Shadakshari	285A	V. Satya Bodha Rao
137A	K. R. Venkataramani	295A	T. S. Rajaraman
138A	D. S. Gopalakrishnan	298A	S. R. Chandra Murthy
140A	Anrudh Kumar Ohri	312A	Uday Bhan Singh Bhadauria
141A	Venkatramaiyer Subbaraman	317A	K. Chandrasekariah
144A	V. C. Parameshivaiah	324A	S. Ameer Jan
147A	R. G. Natarajan	325A	V. K. Harinath
150A	G. B. Renukappa	338A	R. Raghunadha Reddy
153A	K. V. Seshagiri	354A	R. H. Raja Rao
156A	Gurpur Govindraya Pai	355A	B. G. Raja Rao
158A	Ballal Narayana Rao	366A	K. S. Rao
159A	Srinivasan Seshan	372A	Neeragunda Seshadri
166A	Jnyanendra Nath Mohanty	399A	B. N. Taranath
169A	J. Jayaraman	409A	J. Laxminarayana
170A	Babu Nagappa Banajwad	417A	Abdul Khader Saheb
173A	Mehnga Singh	430A	Sree Rama Reddy

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
436A	N. V. Murthy
450A	B. R. Ramachandra Rao
451A	V. S. Mudennavar
478A	Mahendra Nath
481A	Pramodkumar Maneklal Shah
482A	T. G. Sharma
509A	U. Govindraya Bhat
510A	Arvind Ramjibhai Thakkar
516A	B. K. Narasimha Rao
527A	G. V. Singh Chand
529A	Mohan Lal
537A	Rajeshwar Prasad Tiwari
552A	Kuljit Singh
555A	A. N. Guha Ray
593A	Gopalan Padmanabhan
608A	Mahendra Krishnan
610A	Shyam Lal Gogia
611A	Surendra Kumar Girdhar
612A	Vijay Kumar Bhalla
614A	P. U. Jadeja
633A	V. Sundararaman
637A	Rameshwar Dass Gupta
640A	M. R. Khetrapal
645A	Nand Lal Chugh
648A	Sobhagmal Karulal Jain
650A	D. C. Dhawan
651A	L. Vydhianatha Iyer
657A	Sunkara Govardhana Rao
660A	Rajendra Prasad Agarwal
662A	Mohammed Abdul Haleem
667A	Jagdish Chander Bhatia
679A	Ved Parkash Garg
687A	K. B. Venkateswara Rao
691A	Rajinder Paul Battish
692A	Ram Chand Kalra
694A	Avinash Chandra Saxena
695A	K. Satyanarayana Murty
696A	Mathirapilly T. Raphael
697A	Ramji Lal Sharma
699A	B. Umesh Wagle
714A	Deoki Nandan
722A	M. Sivaswamynadar
727A	Guru Bachan Arora
730A	V. Satyanarayana
735A	Arun Govind Joshi
739A	Balbir Singh
740A	Vimal Chandra Sodhani
749A	Surinder Kumar Jain
754A	Shri Prakash Mishra
756A	K. S. Arunachalam
757A	V. K. Gupta
758A	S. P. Mehrotra
772A	Mohan Lal Puri
775A	Manohar Lal Sharda
780A	S. Janakiraman
793A	S. Sivarajan
794A	Rameshwer Dass
795A	Hardyal Singh
796A	Ashok Ramdas Kelkar
817A	Gangadhara Srinivasa Rao
825A	N. Ramaraju
829A	Ranvir Singh Yadav
837A	Kultaran Singh Anand
850A	Narasimhan Santhanam
908A	Prabhu Dayal Tayal
923A	Arjun Dev
928A	Gopal Krishan Gulati
930A	Dattatraya Hari Karmakar
932A	P. S. Chitale
939A	Ramesh Chandra Verma
941A	C. D. Amdekar
943A	Shrikant Damodar Nimbkar
950A	S. M. Palkar
952A	N. C. Bhatia
959A	Sharadchandra N. Thatte
961A	R. Soundararajan
967A	S. A. Siddiqui
968A	Sunder Sugnomal Gurnani
970A	D. N. Goresia
980A	D. J. Khanchandani
981A	G. D. Voling
986A	Tharakkal Ramanunny
993A	B. H. Wadhwani
994A	Roshan Lal
995A	K. N. Bhagavan
1000A	Mukund Vasudeo Joshi
1001A	Anand Pribudas Vazirani
1002A	Dilip Kumar Adhikari
1003A	K. K. Jayaraman
1006A	Pratap Chandra Mitra

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
1008A	V. S. Varkey
1018A	Ramkrishna Madhao Kharkar
1024A	Babubhai Chhotubhai Mehta
1040A	Amrit Paul Chaba
1047A	Saradindu Chatterjee
1065A	R. Srinivasan
1071A	Manjaya G. Shetty
1086A	P. M. Kothari
1087A	S. R. Konkankar
1090A	S. F. Pardawala
1091A	Kartar Sadhermal Israni
1095A	Goruru Royasam Vardarajan
1116A	D. Y. Tulpule
1118A	N. K. Subramanian
1125A	Lekh Ram Sharma
1143A	Mukund Vaman Sardesai
1146A	Hasso Nichani
1173A	B. Sreenivasa Rao
1194A	Vishnu Datt Dhyani
1203A	Suresh Vasudeo Phadke
1213A	Vasudev Gopal Deshmukh
1214A	I. A. Ibrahim Emady
1261A	D. Y. Pathare
1263A	Narasimhan Krishnamachari
1265A	N. H. Kumur
1274A	V. N. Narayanan
1344A	Ramchandran Narayanan
1358A	S. K. M. Shah
1385A	Anand Bhagwant Naik
1391A	P. V. Belapurkar
1394A	Krishkant Ratanlal Shah
1396A	Balram Nanakchand Marwaha
1404A	W. H. Lunavadawala
1414A	Bomanji Nauroji Adajania
1420A	D. K. Korgaonker
1421A	P. K. Korgaonker
1436A	Diwakar Dinkar Parkhi
1446A	Ajit Singh
1482A	S. Ramakrishna
1485A	Krishna Gopal Choudhary
1494A	Dipanguru Mohan Bose
1498A	Sadhan Moy Guha
1502A	Biswnath Chattopadhyay
1522A	Mahadeb Kumar Sarkar
1528A	Tapan Kumar Basu
1530A	Pranab Kumar Sarkar
1532A	Hirendranath Ghosh
1549A	P. K. Chakravorty
1552A	Sujit Krishna Paul
1553A	Amiya Kumar Misra
1566A	Bijay Kumar Muhuri
1579A	Ranjit Kumar Chakrabarti
1582A	Bhabani Prosad Ghatak
1584A	Biswanath Banerjee
1592A	N. G. Zambre
1596A	M. P. Abraham
1624A	Ajit Kumar Das
1626A	Shiv Kumar Jhunjhunwala
1647A	Sunil Kumar Basu
1653A	Debabrata Bharadwaj
1655A	Bishnu Charan Basu
1662A	Bidhan Chandra Ghosh
1680A	Debaprasad Sarkar
1684A	T. T. Isaac
1691A	Paresh Chandra Roy
1704A	Santosh Kumar Nag
1705A	Niranjan Datta
1708A	Asok Kumar Sen
1716A	Chandidas Howli
1721A	Kiranmay Mukhopadhyay
1730A	Shyamal Kumar Sengupta
1745A	Priya Brata Guhathakurta
1749A	M. M. Guin
1752A	Asim Kumar Bandyopadhyay
1784A	Bhupal Chandra Sensarma
1807A	Trilochan Singh Thukral
1811A	Satya Narayan Prasad
1820A	Prosanto Kumar Basu
1826A	Nisit Kumar Pal
1833A	Sisir Kumar Ghosh
1834A	Ranjan Kanti Chakrabarti
1835A	Samir Prasad Ganguly
1839A	Nandalal Basak
1867A	Nabin Chandra Halder
1880A	Chitta Ranjan Deb
1893A	Karunamoy Ghosh
1894A	Jayanta Kumar Sengupta
1896A	Kashiswar Chakraborty
1904A	Sambhu Nath Das
1920A	Wazir Chand Gera

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
1943A	Sasanka Sekhar Ghosh
1953A	M. S. Chatterjee
1976A	Shyamal Kumar Das
2003A	P. K. Gangopadhyay
2006A	Niranjan Saha
2016A	Partha Sarathi Mitra
2024A	Asim Bishnu
2026A	Shyamal Kumar Ghosh
2036A	Ranjit Prasad Banerjee
2075A	P. P. Chattopadhyay
2107A	Mohinder Singh Grewal
2124A	Chandidas Banerjee
2133A	Shiv Kumar Nanda
2143A	Purnendu Bikash Roy
2144A	Phatik Lal Das
2152A	Umashankar Ghose
2155A	D. K. Guha Thakurta
2172A	M. K. Bandopadhyaya
2193A	Ganga Sagar
2198A	R. Venkataraman
2202A	Satish Chandra Paul
2208A	Ranjit Sen Gupta
2219A	Jnanesh Chandra Roy
2243A	Pranab Kumar Sarkar
2262A	P. V. John
2272A	Uma Charan Roy
2279A	Venkiteswaran Viswanathan
2289A	S. K. Chakrabarti
2317A	Milan Kumar Ghosh
2331A	Subir Das Gupta
2339A	A. K. Ghosh
2353A	Krishna Kumar Hazra
2376A	Joginder Singh Oberoi
2383A	Ramkrishna Datta
2384A	Asish Chattopadhyay
2414A	P. S. Bhattacharjee
2415A	Samir Kumar Gupta
2417A	Subir Kumar Chattopadhyay
2423A	Subhash Chandra Khan
2450A	Biswanath Banerjee
2461A	Chiraranjan Chakraborty
2469A	Lokenath Samddar
2481A	Sridhar Chakraborty
2486A	Raj Kumar Soni
2507A	Pranab Kumar Chakravorty
2533A	P. Ahuja
2544A	P. K. Ramasubban
2574A	Hemendra Nath Bose
2575A	Dilip Kumar Sinha
2580A	Subhash Chandra Basu
2591A	Sekhar Mohan Lahiri
2599A	Silla Koteswar
2602A	Rabin Chanda
2603A	Rabindranath Nayak
2606A	Nrusinha Charan Khuntia
2607A	Sudhansu Sekhar Hota
2619A	Brajabandhu Lenka
2622A	Sitarama Panda
2631A	Hrusikesh Pany
2632A	Sk. Abu Bakar
2643A	P. K. Bhuyan
2667A	Prem Kumar Seth
2670A	Prem Narain Ahuja
2676A	Rajinder Singh Bagga
2680A	Ram Dial Aggarwal
2685A	Nand Ram Guria
2686A	Sudershan Lal Batheja
2687A	Surinder Mohan Sehgal
2702A	Sundar Lal Goel
2709A	Jai Narain Gupta
2714A	Milap Chand Bahl
2721A	Amar Chand Jain
2734A	Narinder Kumar Kapoor
2736A	Jas Paul Singh
2738A	Subhash Chander
2741A	J. P. Bharadwaj
2744A	Hem Chand Gupta
2754A	Om Prakash Viksit
2759A	Satindar Kumar Aggerwal
2762A	Mahinder Pal Munjal
2765A	Sham Dass Mehta
2768A	Ashok Kumar Agarwal
2775A	Krishan Kumar Gadi
2776A	G. P. Juneja
2778A	Gurbachan Singh
2781A	Pritam Pal Arora
2793A	Jai Narain Tripathi
2794A	Jagdish Mitter Khetarpal
2809A	Roshan Lal
2812A	Indu Prakash

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
2822A	Vijay Kumar Gangal	3029A	Dharam Paul Mehta
2832A	Vikramjit Singh Sapra	3032A	Satindar Nath Seth
2833A	Naresh Mohan	3038A	Ram Krishna Agarwal
2834A	Chaman Jit Singh	3039A	Prem Parkash Khanna
2842A	Kishin Ranjhomal Bakhru	3041A	Labh Chand
2851A	Rajendra Mudgal	3042A	Dharam Parkash
2852A	Joginder Pal Anand	3047A	Satish Chander Vijh
2854A	S. K. Moorjani	3048A	Subramaniam Vishwanathan
2856A	Dev Raj Singla	3049A	Ramendra Shanker Mathur
2858A	Harish Chander Khurana	3063A	Sham Kumar
2859A	Vir Sain Jain	3071A	H. K. Kulshrestha
2863A	Ram Charan Gupta	3072A	Krishan Dev Sharma
2864A	Rajinder Lal Khitha	3091A	Santokh Singh Gill
2871A	Ram Saran	3104A	Krishan Kumar Mehta
2874A	Shivji Ram	3106A	Jagan Nath Garg
2875A	Brijinder Singh Khurana	3120A	Krishna Pal Singh
2877A	Bijayapal Singh	3124A	Prem Chand
2885A	Khazan Chandra	3127A	Radheyshyam Sethy
2897A	Asa Nand Batra	3130A	J. B. Singh
2905A	Rishi Kumar Govil	3137A	Ramkrishna Rastogi
2911A	Bal Krishna Chopra	3151A	Ram Niwas Sharma
2916A	Madan Lal Gupta	3167A	Sarjit Singh Saini
2918A	Amarjit Singh	3168A	Mahendra Kumar Jain
2922A	Brij Mohan Chokra	3189A	Jasbir Singh Jaggi
2927A	Vinod Kumar Anand	3203A	Manmohan Rai Mehta
2935A	Jagdish Kumar Tuli	3204A	Om Parkash Beri
2939A	Naresh Kumar Sekhri	3205A	Munshi Ram Sachdev
2942A	Vijay Kumar Nanda	3206A	Sushil Kumar Bhatia
2947A	Anand Kumar Syngle	3211A	Niranjan Singh Ailsinghani
2950A	Kishori Lal Gupta	3215A	Rajinder Kumar
2954A	Triloki Nath Bhatnagar	3231A	Kirpal Singh Karvi
2955A	Chander Parkash Batra	3237A	Prem Nath Seth
2959A	Ratan Lal Chablani	3240A	Jagdish Mitra
2966A	Pran Nath Puri	3249A	Atam Prakash Mahajan
2971A	Mahesh Chander Dhawan	3251A	Gautam Kumar Kapur
2975A	Bhim Sain Mehta	3257A	Bhagwan Matai
2977A	Mitter Sen Garg	3259A	D. N. Rawal
2979A	Prabhu Dayal	3271A	Harjit Singh Ahluwalia
2995A	Prem Chand Jain	3298A	Madan Gopal Alagh
2998A	Harpal Singh	3304A	Indar Jit Singh
3002A	Surinder Kumar Thapar	3309A	Narendra Mohan
3009A	Vasu Dev	3322A	Surinder Kumar Khanna
3015A	Bhagwan Singh	3325A	Amrik Singh Parmar
3017A	Jagdish Chander Malhotra	3332A	Sat Paul Varma
3024A	Radhe Shyam Goel	3342A	Ishwar Chander

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
3370A	Ram Asra Adlakha	3781A	Yudhishtar Soni
3384A	Sohan Lal	3783A	Kailash Chander Rampotra
3393A	Chaman Lal Buth	3797A	Ved Mittra Mohla
3405A	Haresh Ambwani	3802A	Pushkar Nath Dhar
3408A	Raj Kanwar	3803A	Ramesh Chandra Sharma
3414A	S. Iyer Srinivasan	3807A	Ved Parkash Jindal
3415A	Hari Chand Gupta	3847A	Harnam Das Gupta
3439A	Ram Singh	3850A	Ashok Kumar Nayar
3442A	Kesho Ram Jain	3869A	Prem Sagar Aneja
3451A	Mohinder Nath Mathur	3871A	Ishar Singh
3458A	V. R. Chopra	3882A	V. V. Puthenkulathil
3478A	R. V. Agrawal	3883A	Sushil Chandra Karmakar
3481A	Banarsi Dass Sangal	3924A	Gour Gopal Brozobasi
3484A	Krishan Chander Sidhwani	3926A	Bhaskar Jyoti Sen
3503A	M. R. Prabhakar	3932A	Himanshu Sekhar Nath
3544A	Surendra Kumar Bajaj	3946A	N. R. Jonnalagadda
3545A	Shyam Behari	3947A	Meka Krishna Murthy
3551A	Krishan Swaroop Gangal	3950A	Bijoy Krishna Mahapatro
3578A	Udai Vir Singh	3954A	Vemula Venugopalachetty
3585A	Jogindar Singh	3968A	V. D. V. S. Krishnarao
3586A	Shri Chand Gupta	3977A	B. Venu Gopal
3590A	Mahesh Chander	3982A	Dosa Satyanarayanamurty
3593A	Om Parkash Chugh	3997A	Gummadi Venkateswara Rao
3596A	Dharmadhar Arya	4008A	Mohini Mohan Rout
3600A	Balbir Singh Sekhon	4013A	N. Radhakrishnamurthy
3609A	Prem Chand Srivastava	4023A	Duggirala Dhanvantary
3614A	Ashok Kumar Mehta	4030A	Mallu Gangireddy
3615A	Madan Mohan Sharma	4034A	V. Kakumanu
3639A	Gurdayal Singh Bhalla	4038A	Kolluru Krishnamurty
3640A	Satya Narayan	4046A	A. V. Narayanappa
3643A	Narendra Kumar Jain	4058A	Vengala Krishnamurty
3668A	Sham Lal Sharma	4073A	Meka Nageswara Rao
3669A	Kamal Kishore Kapoor	4084A	Mohammed Moinul Hasan
3681A	Vidya Bhushan Sharma	4092A	Uckoo Prahalad
3689A	Jagdish Chander Gupta	4101A	Checka Suryanarayana
3690A	Ram Parkash	4102A	J. L. Narasimha Sarma
3691A	Pritam Lal Dhingra	4117A	K. S. Dikshitulu
3693A	Hans Raj Dang	4134A	Cholimela Pochiah
3699A	Daya Nand Sharma	4167A	H. S. Subba Rao
3712A	Dev Dutta Sharma	4179A	Chandra Prakash
3722A	Hari Singh Dhankher	4181A	V. Paulose
3737A	Inder Raj Sakhuja	4191A	K. R. Chettiar Murugesan
3745A	Gurmel Singh Matharu	4195A	V. Harihar Iyer
3764A	Sushil Kumar Parasher	4219A	Surendra Kumar Nagpal
3778A	B. K. Goel	4227A	G. N. Chakraverty

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
4231A	Ishwarchand Jain
4248A	K. G. Sri Raman
4285A	Mustaq Ahmed
4294A	Madan Lal Sharma
4306A	Mohan Nanikram Jethra
4313A	U. B. Motiramani
4318A	M. G. Shivdasani
4331A	Malkiat Singh Panesar
4340A	S. C. Jain
4344A	Satya Pal Arya
4348A	Satya Pal Bawa
4349A	D. K. Gopalani
4354A	Prabhakar Jagannath Joshi
4379A	Arvind Prasad Mathur
4385A	Dhirendra Singh
4400A	Mahendra Singh Chaudhary
4427A	Dushyant Kumar Shringi
4434A	Beni Gopal Goyal
4452A	Rama Kant Arya
4453A	Krishan Chandra Garg
4459A	T. Viswanadhan
4467A	Kali Pada Ghosh
4473A	N. J. Somayazulu
4474A	V. K. Venkatraman
4477A	Sheo Mohan Mishra
4478A	Mohammad Sajjad Quraishi
4480A	A. Iyer Vaidyanathan
4481A	K. C. Singh Yadava
4511A	D. Sreeramachandramurthy
4532A	Rattan Singh
4536A	Ram Ballava Sharan Mishra
4548A	Nishith Chatterjee
4556A	P. V. Gopalan
4568A	M. K. Deepak Gargya
4569A	Deo Kishan Joshi
4571A	Het Ram Sewta
4576A	G. Ganesan
4585A	Anand Udharam Thawani
4589A	Ram Krishna Kapoor
4604A	Arvind Kumar
4610A	Badri Narayan Sinavaria
4624A	Shanti Chand Bhandari
4628A	Hans Raj
4629A	Hanuman Singh Bhati
4630A	K. Ganganarayan Mathur
4635A	Ved Prakash Talwar
4638A	Vinod Kumar Nigam
4640A	Triloki Nath Maini
4647A	Vishwambhar Dayal Gupta
4648A	Shambhoo Dayal Gupta
4653A	Avadh Naresh Dubey
4661A	Abbayareddi Jayaraman
4667A	Shiva Kumar Tiwari
4670A	Basant Ram Dikshit
4692A	Bishnu Pada Rakshit
4698A	Krishna Murari Srivastava
4701A	Tarlochan Singh Bhatia
4702A	Dhian Singh
4703A	K. P. Srivastava
4711A	Bharat Bhushan Rajpal
4724A	Kuldip Raj Anand
4730A	Vishwa Nath Tripathi
4736A	Mahesh Chandra Kheterpaul
4748A	Bishun Dayal Srivastava
4768A	P. N. Tandon
4772A	Umesh Chandra Shukla
4783A	Tej Pal Singh
4784A	Sheo Nath Lal Srivastava
4790A	Jatinder Nath Varma
4794A	Shri Ram Gupta
4795A	Prem Nath Soni
4797A	Brij Mohan Gupta
4798A	S. Singh
4802A	L. M. Rajaram Rajput
4803A	Subhas Chandra Gandhi
4806A	Moin Uddin Ahmed
4807A	Rabindra Nath Majumder
4821A	Mahesh Chandra Saxena
4823A	Anupam Bagchi
4827A	R. P. Tripathi
4830A	Jagdish Chandra
4831A	Shyam Bihari Singh
4836A	Chittaranjan Chakravarty
4839A	Dwarka Prasad Gupta
4840A	Amar Singh
4848A	Satya Narain Tandon
4850A	Om Prakash Agrawal
4855A	Madhav Manaharamani
4857A	Om Prakash Sachdev
4861A	Shyam Murari Gupta

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No	Name of candidate
4867A	Sat Parkash Jindal
4884A	S. S. Bhatnagar
4912A	Vishnu Kant Mishra
4924A	Kamala Prasad Singh
4925A	Sushil Chandra Agarwala
4939A	U. S. Saxena
4989A	Harmesh Kumar Soni
5019A	M. Suryanarayanamurty
5020A	Ajai Kumar Singh Rathor
5027A	Pramod Ganesh Bhagwat
5035A	D. P. Agarwala
5052A	Ved Prakash Agarwal
5057A	Satish Kumar Khurana
5060A	T. V. Antony
5065A	D. Srinivasan
5076A	K. B. Palaniswami
5077A	Ramaswamy Thirunarayanan
5080A	V. S. Krishnamurthy
5082A	Velanki Suryaprakasa Rao
5083A	Chandra Sekhar Mishra
5090A	K. Rama Panicker
5109A	Kandeth Ravi
5114A	Srinivasan Raman
5119A	S. Subramanian
5121A	S. Mohideen Abdul Kadir
5122A	C. Ravindranathan
5123A	Kurapati Sankara Rao
5132A	C. S. Venkatasubramanian
5135A	R. G. Ramesh
5136A	Duraiswamy Bhuvaneswaran
5140A	Jampala Pitchaiah
5156A	T. Periasamy
5162A	A. S. Viswanathan
5169A	Vadangi Ramakrishna Rao
5191A	Subbayya Muthukrishnan
5195A	Rajagopalan Doraiswamy
5198A	P. Eswaramoorthy
5202A	M. R. Sundaramurthy
5212A	Kasa Radhakrishnan
5215A	G. Anandan
5223A	N. S. Balakrishnan
5232A	Sarat Kumar Pati
5237A	K. R. Vasu
5238A	R. Venugopal
5240A	Sure Venkata Rao
5243A	D. Ananthapadmanaban
5249A	C. Suryanarayana Natarajan
5250A	G. Venkata Raman
5256A	M. P. Krishnan
5258A	M. Balaramaiah Setty
5269A	Md. R. Pasha
5272A	S. S. Krishnamurthy
5277A	P. V. Krishnamurthy
5281A	A. V. Ramamurthy
5289A	Mirza Shoaib Baig
5290A	S. N. Ratha
5291A	Gour Chandra Mishra
5310A	Giridhari Gauna
5311A	Ananta Bholo
5313A	A. M. Krishna Murthy
5319A	T. Ellappan Subbarayan
5323A	K. R. Bashyam
5324A	Easwaran Ramaswamy
5329A	C. N. Asokapanicker
5333A	Kaza Satyanarayana
5338A	P. M. Kunhu Mohamed
5346A	S. Krishnasubramanian
5347A	K. S. Rathakrishnan
5350A	G. Atchuta Rama Raju
5357A	T. Shanmugam
5358A	K. Ahindra Kumara Varma
5359A	Venugopal Krishnaraj
5379A	V. S. Rajeswaran
5381A	K. Srinivas Rao
5386A	A. Subramanian
5399A	Doraiswamyiyer Sundaram
5418A	K. Balakrishnan
5428A	M. Venkataratnam
5446A	Kalarikal Savier Joseph
5456A	D. Satyadev Mothirami
5460A	Lakshmi Kanta Pattanaik
5489A	V. Ghanasambandam
5505A	C. R. Baskaran
5514A	Vaidyalingam Jagannathan
5517A	Ramaswami Sethuraman
5551A	Nagaraja Ramachandran
5552A	Bandar Subramaniam
5603A	Vangara Ranga Rao
5604A	Vasudeva Gopalan
5617A	Sarjit Singh Sodhi

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
5621A	Handattu Shankar Nayak
5622A	S. Lakshminarayanan
5630A	K. K. Raveendranathan
5654A	Malapaka Lakshminarayana
5696A	T. N. Narayana Rao
5698A	S. R. Jayaraman
5714A	S. N. Mangalmurti
5715A	Arjun Nath Kao
5717A	Chandrakant Damodar Kale
5737A	P. T. Anthony
5740A	N. C. Khandlrwar
5759A	Madan Mohan Lal Chhiba
5761A	Raghunath Rao Mudliar
5783A	Jayant G. Dahigaonkar
5803A	Indra Jit Sharma
5805A	Rajinder Pal Goyal
5808A	Pari Lal
5809A	Jagir Singh
5812A	Naranjan Lal Shahi
5813A	Atma Ram
5819A	Harbans Lal Jolly
5820A	Ramesh Chander Bhargaya
5821A	Pyara Lal
5827A	Jagir Singh Dadhiala
5828A	Vir Paul Singh Sidhu
5830A	Darshan Singh
5834A	Ram Parkash Bhatia
5842A	Balraj Kumar Sharma
5843A	Jiwan Singh
5852A	Rosan Lal Verma
5855A	Narinjan Singh Neena
5857A	Prem Nath
5861A	Santosh Kumar Garg
5865A	Ramesh Kumar Sharma
5872A	Gurchettan Singh Hundal
5881A	Krishana Jiwan Jain
5885A	Jagjit Singh
5890A	Suresh Chander
5891A	Nathu Ram Dandara
5895A	Man Mohan
5897A	Joginder Singh Kohli
5902A	Harbhajan Singh Makkar
5904A	Abnash Chander
5907A	Sudesh Kumar Anand
5908A	Harbhajan Singh
5914A	Raj Kumar Tandon
5915A	Ram Kumar Chadha
5921A	Om Parkash Kalia
5927A	Thakar Singh
5935A	Muni Lal
5948A	Balbir Singh
5963A	Darshan Singh Nagpal
5965A	Amrik Singh
5975A	Prem Kumar Sharma
5980A	Jog Raj Chandan
5990A	Narinjan Singh
5992A	Kirpal Singh
6003A	Munshi Ram
6013A	Rajinder Nath Matharu
6017A	Mahindra Singh
6021A	Shagan Lal Arora
6034A	T. S. Kochhar
6038A	Dhanpat Rai Goyal
6041A	Sagar Chand Gupta
6050A	Vidya Sagar Bhatia
6051A	Rasham Singh Jaswal
6052A	Harbans Lal Gera
6066A	Puran Chand Luthra
6068A	Yash Paul Soi
6069A	Chaman Lal Kochher
6073A	Lakshmi Narain Aggarwal
6074A	Inder Paul Magoo
6075A	Bhagwan Dass
6080A	Manjit Singh
6088A	Aunkar Nath Sood
6092A	Om Parkash Dhiman
6097A	Om Parkash Dhiman
6119A	Bhagwant Singh
6148A	Shiv Shankar Pandit
6178A	Rajeshwar Mishra
6180A	Harihar Singh
6184A	Ram Nandan Sharma
6196A	Om Prakash Yadav
6208A	Ragunandan Singh
6228A	Amar Nath Trivedi
6241A	Raj Kumar Tewari
6250A	Sita Ram Prasad
6262A	Bhoj Raj Singh
6268A	Bishun Deo Singh
6269A	Mozammel Haque

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate
6282A	Bhagwat Pandey
6296A	Harihar Prasad
6302A	S. N Chakraborty
6316A	Diwakar Jha
6340A	Ram Nandan Sharma
6356A	B. V. Kolhatkar
6358A	Nemlal Deviram Gawali
6362A	V. Gopal Rao
6367A	Sharad Sadashiv Deshpande
6370A	B. G. Sane
6377A	K. N. Malghan
6378A	Yashavant Atmaram Pathak
6380A	S. G. Kamath
6386A	Nishikant Narayan Kale
6396A	K. P. Cheriyan
6401A	R. V. Jawadekar
6407A	M. R. Ambike
6426A	Sadanand Namdeo Mone
6430A	Chintaman Sitaram Dande
6437A	V. K. Bhatia
6440A	Vasant Laxman Kulkarni
6443A	Madan Mohan Choudhary
6446A	A. C. Gondhalekar
6456A	Padmakar Yeshwant Sathe
6480A	Satish Kumar
6494A	Vinayak Hanamant Palande
6502A	Jayant Annaji Shrotri
6510A	L. B. Narahari
6533A	Prabhaker Balaji Katakkar
6536A	S. Nagarajan
6542A	Koorma Narayan Gothe
6552A	R. Ramabhadram
6464A	Rudra Narain Anand
6576A	Abhik Kumar Mukhopadhyay
6611A	S. S. Godbole
6616A	Shrikrishna Eknath Joshi
6619A	Sudhakar Vishnu Joshi
6653A	S. S. Gaikwad
6680A	Brij Lal
6683A	K. Mukhopadhayay
6707A	Nirmal Kumar Misra
6713A	Alakh Deo Prasad
6739A	Jagdish Prasad Gupta
6750A	Ram Nath
6751A	Ram Lal Gupta

Roll No.	Name of candidate
6753A	Krishan Kumar Kalra
6761A	Sita Ram Garg
6769A	Kailash Chand Goel
6771A	Bhagwan Govind Rao
6775A	P. N. Mahrotra
6780A	Brahma Prakash
6782A	Shri Ram Verma
6783A	Rattan Dev
6793A	R. K. Jindal
6795A	Sundaresan Venkatesan
6813A	Shiv Raj Singh Tiagi
6817A	Tushar Kanti Roy
6820A	Radha Krishna Gupta
6833A	Hakim Singh Yadav
6837A	Aswini Kumar Sahana
6846A	Mahendra Kumar Mittal
6851A	Adarsh Kumar
6871A	Harcharan Singh
6884A	Santosh Kumar Mohanty
6890A	Paramananda Tripathy
6896A	K. C. Pavithran
6906A	P. Srihari Rao
6909A	Bhabani Sankar Das
6912A	Chaman Lal Drabu
6916A	Somasundaram Natarajan
6939A	V. G. James
6946A	T. K. Joy
6947A	B. Krishnankutti Nair
6948A	A. K. John
6949A	P. Narayana Pillay
6951A	Jacob Nainan
6954A	S. Upendran Nair
6963A	P. G. Krishnan Nair
6970A	P. M. Kunhimohamed
6977A	Thompson Paulus
6990A	P. Divakaran Pillai
7001A	Varghese Idicula
7003A	Rameshwar Dutt
7011A	C. V. John
7025A	Thottathu Kesavan Asokan
7040A	K. Sankar Pillai
7050A	A. Y. Kochukunju
7057A	I. Pathrose
7067A	M. P. Vasudevan Pillai
7071A	S. N. Gopinadhan

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
7072A	S. Kulathu Iyer	7111A	P. S. Rama Sarma
7073A	M. Dharmalingam	7121A	Y. S. P. C. Malleswara Rao
7077A	R. C. Das	7130A	Om Prakash
7081A	Vegi Venkataramana	7134A	Katrapaty Jagannadharao
7082A	Rachakonda Narayana Murty	7140A	Chandaram Thatha Rao
7083A	K. Umamaheswara Rao	7142A	Tayi Subrahmanyam
7084A	Bommana Krishnamurthy	7147A	P. S. Ramakrishna Rao
7085A	N. S. H. V. Subbarao	7160A	K. H. Prasada Rao
7089A	Saveeaiyer Srinivasan	7164A	N. H. Subramonia Iyer
7091A	Kondichetty John Jai Raj	7177A	E. Venkateswarlu
7100A	Korrapaty Sriramamurty	7188A	Satish Kumar Pruthi
7102A	Krishnam Raju Sagi	7194A	Shakti Kumar

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B
(Existing Scheme)

Roll No.	Name of candidate	Roll No	Name of candidate
10B	J. V. Thakkar	214B	P. P. Samarth
11B	Man Mohan Kumar Midha	217B	Subhash Chander Bhatia
24B	B. N S. Kumaran	218B	Dilbag Singh
30B	Nalinaksha Mutsuddi	228B	C. K. Ramanathan
34B	Tukaram Shridhar Panakar	231B	Rajagopalan Vasudevan
37B	Parkash	234B	Gunturi Varadayya Sastry
44B	Kuppakkatu Paily Mathulla	237B	P. N. Kota
59B	D. N. Lakshminarasimhiah	240B	Karunakara Govinda Shetty
75B	Rajendra Kumar Agrawal	248B	Tushar Kanti Sen
84B	D. N. Parameswara Guptha	252B	Balkrishan Varma
100B	K. K. George	256B	R. M. Singh
105B	N. T. Siddaramannanavar	264B	A. M. Gosalia
116B	L. Gundappa Vasantharao	268B	S. Pattabhy Subba Rao
119B	K. G. Rao	273B	P. D. Nayak
120B	B. L. Pandurangiahsetty	276B	Balaji Shankar Joshi
128B	Jagdish Chandra Verma	288B	V. G. Krishna Iyer
137B	S. Raghunathan	298B	S. N. Bandyopadhyaya
152B	I N. Ailsinghani	303B	Dinabandhu Biswas
158B	K. Buchimohana Rao	308B	H. Sen Gupta
160B	Gokul Chandra Srivastava	310B	Sailendra Nath Banerjee
161B	A. C. K. Radha Krishna Murty	311B	P. K. Lakshman
165B	Bhushan Lal	312B	Jugal Kanti Chakravorty
166B	Om Prakash	313B	Haridas Debnath
178B	D. M. Adanwala	314B	P. R. Krishnamurty
179B	Satya Pal Gorowara	316B	Surindar Paul
181B	Sudhakar Moreshwar Gangal	317B	Sumalya Mazumdar
201B	G. V. Venkatachalam	322B	Asit Kumar Bhattacharyya
202B	R. K. Parikh	323B	Abu Torab Mallick

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate
335B	Amulya Kumar Das
347B	Asit Kumar Roy
348B	Rebatikanta Bhattacharyya
350B	Susobhan Sengupta
354B	R. Naganathan
357B	Rabindra Nath Banerjee
359B	Subramanyya Padmanabhan
361B	Sunil Chandra Mukherjee
363B	Jaynarayan Kumar
387B	Samar Nath Goswami
391B	Syama Pada Kole
394B	Himangsu Bhusan Paul
427B	Mahesh Chandra Shah
429B	S. N. Chakraverti
432B	Tapan Kumar Banerjee
435B	Prasanta Kumar Chatterjee
437B	Samir Nath Bhattacharya
444B	Tarapada Dutt Sarma
445B	Bhaskar Nath Barat
447B	Sushil Kumar Biswas
451B	Mahesh Chandra
452B	Asim Kumar Sarkar
459B	Manikkoth Purushothaman
462B	Chittapriya Banerjee
466B	Tushar Kumar Ghosh
479B	Manindra Nath Pal
488B	S. B. Rautaraya
490B	K. C. Mahapatra
492B	K. C. Swain
493B	Bijaya Kumar Patra
502	Gokulananda Biswal
503B	Prafulla Chandra Patnaik
506B	Mahesh Chandra Patra
507B	Suresh Chandra Mall
509B	Gouranga Charan Samal
512B	Konala Atchuta Rami Reddy
529B	Hem Chand Jain
532B	Romesh Chander Pahwa
533B	Inder Prakash Mullick
537B	Mahesh Kumar Jain
558B	Brij Mohan Lal
565B	Dharam Vir Gupta
581B	Ram Sarup
583B	Shyam Narayan Sharma
584B	Rajindar Singh
587B	Shyam Sunder Dua
589B	Sham Sundar Nandwani
596B	Ved Parkash Wasan
597B	R. K. Sehgal
616B	K. K. Katial
618B	Kishin Bhagwandas Bhatia
619B	Jagdish Kumar Dewan
620B	Sat Pal Singh Dogra
625B	Kharaiti Lal Pruthi
630B	Anant Sharan Jindal
637B	Gurdev Singh
638B	Onkar Singh
651B	Ram Nath Tyagi
652B	Pushp Raj Gurwara
657B	R. V. Singh
662B	Krishan Kumar Taneja
666B	Manohar Lal Kapoor
667B	Didar Singh Makadam
683B	Surendra Singh Negi
684B	Kuldip Chandra Vij
685B	Rajender Kumar Arora
694B	K. K. Bhatia
705B	Lakshmi Chand Arya
710B	Krishan Kanwar
721B	Ish Kumar Khurana
727B	Amrit Lal Aggarwal
741B	Guttu Mal Gupta
746B	Mohan J. Chawlani
747B	Naresh Kumar Gupta
748B	Ram Nath Tandon
757B	Harbans Lal Kamra
759B	V. Sri Ramachandra Rao
767B	Bisweswar Paul
780B	Ish Kumar Sehgal
792B	V. C. Narasimhulu
793B	K. S. Murty
802B	R. Ragupathi Naidu
813B	D. G. Krishna Rao
819B	Kolli Venkateswara Rao
830B	B. S. Sastry
831B	A. Madhusudhana Rao
838B	C. M. Reddy
851B	Vemuri Ramachandra Rao
867B	Challa Pedda Rangaiah
895B	B. Venkateswara Sarma

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate
927B	Yash Pall Arora
932B	Subramaniam Ramamoorthy
935B	Bhaskar Vishnu Pimplikar
942B	Amar Chandra Saxena
945B	Tahil Manghmani
948B	C. K. Jhuremalani
950B	Udai Chand Jain
951B	Swaroop Chand Binaykiya
969B	J. I. Venkateswarlu
970B	V. Appa Rao
973B	Anshumali Chakravorty
974B	Mohinder Singh Gill
978B	S. P. Kumar Dash
985B	Anand Prakash Trivedi
990B	Narain Bahadur
995B	Mool Chand
996B	Vishnu Dass
1001B	Gian Chand
1006B	Vijai Krishna Gupta
1008B	M. K. Khurana
1012B	Satish Kumar Sharma
1019B	Naresh Chandra Verma
1020B	Andh Narain Mall
1026B	U. N. Srivastava
1032B	Brij Raj Kishore
1036B	Virendra Pratap Agarwala
1051B	M. P. Sethi
1065B	Balraj Lamba
1070B	A. C. Mulchandani
1072B	K. Satyanarayanan
1074B	Balakrishnan Sambandhan
1077B	A. V. R. Prasada Rao
1082B	P. N. Bakthavatchalan
1084B	S. Ramamurthy
1089B	Ananthachari Sampath
1091B	M. Kuppuswamy
1102B	M. N. Rajagopalan
1106B	K. R. Raghunandan
1117B	Kuppuswamy Swaminathan
1119B	M. Srinivasan Venkataraman
1123B	R. Jahangir Khan
1124B	R. Sreenivasarao Sudhakara
1127B	Asoori Rangaswami
1131B	K. N. Ravindra
1132B	R. Anantha Rama Krishnan
1137B	M. Gopalakrishnan
1146B	B. Mathiprakasam
1147B	K. Sankara Iyer
1156B	Murugesa Govindaraj
1165B	J. S. Bhalachandra
1168B	V. Babu Rajendra Prasad
1174B	T. S. Vasan
1176B	Inagalla Rama Rao
1178B	Chandra Mohan C. Williams
1179B	Kanniah Santhanakrishnan
1182B	T. S. Ramakrishnachari
1185B	V. Kesavalu
1189B	Sirugudi Madhava Rao
1190B	Noshir Ardeshir Marphatia
1194B	C. Ramaratnam
1208B	Shaik Mahaboob Badusha
1247B	Vura Suryanarayana Murty
1252B	Rameswamy Sampath
1269B	P. A Verghese
1278B	Vasudevan Kannan
1281B	S. Sivagnanam
1282B	M. R Upadhyaya
1296B	K. Lakshmi Kanthan
1298B	V. Vasudeva
1305B	K. R. Krishna Sarma
1308B	T. S. Raghunathan
1318B	Sadgur Prakash Srivastava
1325B	Roshan La Kochhar
1326B	Harjap Singh Riyait
1327B	Avtar Nath Khosla
1328B	Krishan Kumar Kasturia
1329B	Kali Charan Dass Kapur
1335B	A. K. Goswami
1344B	Inder Jit
1346B	Dev Raj Sethi
1349B	Sonki Ram
1359B	Gurmukh Singh
1363B	D. R. Alwadhi
1368B	Avtar Singh
1370B	Mohindar Singh Mann
1372B	Charanjit Singh Kanwal
1379B	S. D. Singh
1381B	Sat Paul Bhatia
1383B	G. S. Randhawa
1386B	K. N. Thirumoolakantan

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate	Roll No.	Name of candidate
1388B	Virsa Singh Mall	1525B	Subarnabindu Datta
1389B	Sita Ram Sharan Mathur	1540B	Chandra Sain Gupta
1390B	Krishan Kumar	1544B	Girish Kumar
1392B	K. S. S Verma	1546B	Salek Chand Jain
1393B	Ram Krishna Sharma	1554B	N. K. Sharma
1410B	Sukhwant Singh Sidhu	1556B	Brij Mohan Gulati
1418B	L. P. Sinha	1580B	Ishar Singh Tara
1421B	Gopendra Narayan Bhowmik	1589B	P. K. Abraham
1422B	Balbir Onkar Singh	1606B	S. Kalyanaraman
1428B	Devendra Singh	1610B	M. V. Ganesan
1445B	Samar Bijoy Basu	1625B	Raya Samuel Prabhakararao
1447B	V. V. Ramana Rao	1626B	R. Jayaraman
1456B	Debaprasad Chatterjee	1628B	Talla Kotilingam
1468B	Mahendra Prasad Singh	1638B	Kappala Sanjeeva Rao
1478B	Bhisham Lal Gogia	1643B	Patnala Satyananda Rao
1499B	Dattatraya Keshav Phatak	1651B	Guduluru Venkateswarlu
1500B	Vijay Shankarao Tembe	1654B	Subramania Ganesan

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION A

New Scheme

Roll No.	Name of candidate	Roll No.	Name of candidate
67NA	B. S. Manje Gowda	1939NA	Dhuna Chandra Sahoo
79NA	B. S. Rangappa	1941NA	H. L. Udupa
182NA	H. S. Rangarajan	1969NA	K. Rajasekaran
361NA	Kapil Dev	2030NA	A. P. Viswambharan Nair
386NA	V. Deenapathy	2046NA	Brundaban Sahu
472NA	S. Parameswara Iyer	2122NA	Balvir Raj Gupta
1277NA	Upendra Nath Baral	2245NA	Raj Kumar Dhawan
1282NA	M. Bhadri Raju	2580NA	Brij Pal Singh
1294NA	J. Singh Jangi	2684NA	N. Sadanandan
1516NA	M. L. Virwani	2709NA	R. Gopinadhan Pillai
1620NA	Om Prakash Gupta	2756NA	Vaka Krishna Reddi
1798NA	Sumonto Mohanty	2763NA	M. Nageswararao

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B

New Scheme

Roll No.	Name of candidate	Roll No	Name of candidate
Civil		83NB	C. Mohana Reddy
5NB	P. Vasudeva Rao	89NB	P. Satyanarayana Murty.
26NB	Somanath Nanda	123NB	Dau Dayal Saxena
55NB	Laxmi Lal Mathur	125NB	S. Ramaswami
77NB	R. Narasimhan	126NB	M. Viswanathan
82NB	S. V. Bhaskara Reddy	128NB	K. Rajarao

ASSOCIATE MEMBERSHIP EXAMINATION—SECTION B (*contd.*)

Roll No.	Name of candidate
Mechanical	
225NB	J. S. Sathe
228NB	Bhagwan Dass Malbotra
Electrical	
254NB	H. C. Agarwal
262NB	Arvind A. Deshmukh
263NB	V. N. Jayaraman
265NB	R. R. Kandaday
269NB	Byomkesh Ganguly
293NB	R. Jagannathan
294NB	D. Rangarajan
303NB	C. V. Ramaniah
314NB	Dharam Pal Gambhir
315NB	Tej Singh
Metallurgical	
337NB	K. P. Lachhwani
340NB	B. K. Arora
344NB	P. N. Jhingran
Electronics & Telecommunication	
357NB	C. K. Sankaranarayanan

FORTHCOMING CONFERENCES

Nineth Irrigation and Power Seminar, Trivandrum, October 26-27, 1964

The Nineth Irrigation and Power Seminar will be held at Trivandrum, Kerala, on October 26-27, 1964. The following subjects will be discussed at the seminar :

1. Rehabilitation and resettlement of displaced persons from river valley projects.
2. In-service training of irrigation engineers in agricultural matters, particucularly cropping pattern, water requirements of various crops, etc.
3. Power requirements and discussions of Load Survey Committee's Report.
4. Progress and problems of adoption of metric system in irrigation and power projects.
5. Discussion on the report of the Nijalingappa Committee on financial aspects of irrigation projects.
6. Discussion on the report of the Venkataraman Committee on financial working of the State Electricity Boards.
7. Symposium on 'Steps for Speeding up Irrigation and Rural Electrification Targets' for the first Mahatma Gandhi Birth Centenary in 1969.

Members desirous of contributing papers may send their papers in duplicate to the Deputy Director (Seminar), Central Water and Power Commission, New Delhi, before August 15, 1964.

Further details can be obtained from the Director (Cost Control), Central Water and Power Commission, New Delhi.

Residential Conference on 'Audio-Visual Teaching Aids', Loughborough, September 10-12, 1964

A residential conference on 'Audio-Visual Teaching Aids' will be held at Loughborough College of Technology from September 10 to 12, 1964. Arranged by the

Science and General Division Professional Group on Education and Training of the Institution of Electrical Engineers, London, the conference will cover such topics as educational and teaching films, closed-circuit television, calculus programming and teaching machines. The aim of the conference is to bring together tutorial staff, industrial training officers, and those interested in education and training to discuss the progress that is being made in the development of aids to teaching, and the possibility of arranging for cooperation if the production of more suitable material for teaching machines than is at present available.

A scientific exhibition will run concurrently with the discussion sessions. Offers of exhibits are invited within the following categories : (i) audio visual aids, including teaching machines, language laboratories, closed-circuit television, video tapes and loop films, (ii) electrical engineering laboratory demonstration equipment, and (iii) apparatus developed at teaching establishments, including laboratory and demonstration equipment for electrical engineering courses and general and special courses for technicians, and college-built audio-visual aids. Those wishing to offer exhibits for consideration for inclusion in the exhibition should apply to the Secretary of the Institution for application forms as soon as possible.

Further information and registration forms are available from the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C. 2.

Fourth International Conference of the International Association for Analogue Computing, Brighton, September 14-18, 1964

The Fourth International Conference of the Association for Analogue Computing will be held in Brighton, England, from September 14 to 18, 1964. The theme of the conference is 'The Theory and Application of Analogue and Hybrid Computing'. About 100 papers have been accepted for the conference dealing with subjects such as : (i) Applications to industrial problems including heat transfer problems; (ii) Solution of mathematical problems; (iii) Solution of partial differential equations, including network techniques; (iv) Optimization techniques; (v) Applications to medical problems; (vi) Modern development in computing equipment; and (vii) Automatic programming techniques. It is expected that the papers will be of interest not only to scientists and engineers whose prime interest is in analgoue computation, but also to those whose interests lie mainly in digital computation.

Further details can be obtained from The BSC/AICA Honorary Secretariat, Ferranti Ltd., Kern House, 36 Kingsway, London, W.C. 2.

37th Annual General Meeting of the Water Pollution Control Federation, Bal Harbour, September 27-October 1, 1964, and San Juan, October 4-7, 1964

The 37th Annual General Meeting of the Water Pollution Control Federation will be held in Bal Harbour, Florida, U.S.A., from September 27 to October 1, 1964, and the re-convened session of the meeting will be held in San Juan, Puerto Rica, from October 4 to 7, 1964.

A comprehensive programme covering all phases of water pollution control is arranged by the Federation.

Further details can be obtained from the Water Pollution Control Federation, 3900 Wisconsin Avenue, Washington, D.C.

Third Congress of the International Council for Building Research, Studies and Documentation, Copenhagen, August 23-28, 1965

The Third Congress of the International Council for Building Research, Studies and Documentation (CIB) will be held in Copenhagen, Denmark, from August 23 to 28, 1965. The theme of the congress is 'Towards Industrialized Building'. It is expected that the congress will be of interest to engineers connected with building research, planning, design, construction or with one of the many industries associated with building.

The congress theme is divided into 10 groups dealing with the following subjects :

1. The Changing Structure—focus on a new industry : its structure and the market.
2. Intergration of Design and Production—industrial production methods reflected in design : the development cycle, typification, rationalization of the design process.
3. Planning of Operations—industrial planning methods applied to building operations : modern planning principles, cost control.
4. Regulations—from restriction to production stimulus.
5. Modular Standardization—dimensional coordination and standardization applied in practice.
6. Production Methods—industrial production methods in house building : factory location, prefabrication, organized assembly.
7. Materials Development—the influence of industrialization of building on the development of materials : new requirements, new possibilities.
8. Functional Requirements—functional analysis to establish the basis for design and for the production programme.
9. Developing Areas—industrialisation at various stages : specific problems and general aims.
10. Communicating the Knowledge—development and transmission of knowledge : integration of research and production, feedback.

Two or three sessions will be running at the same time, keeping as far as possible sessions with related subjects in consecutive order so as to enable participants to attend all sessions within their field of interest. About 200 papers will be presented.

Further particulars can be obtained from the Secretariat of the Third Congress of the CIB, c/o Dis Congress Service, 19 Sankt Peders Straede, Copenhagen, K, Denmark.

E.H.V. Transmission Equipment Conference, September 27-October 1, 1965

The Power Division of the Institution of Electrical Engineers is organising a conference on 'Design Criteria and Equipment for Transmission at 400 kV and Higher Voltages' to be held at Savoy Place from September 27 to October 1, 1965. The aspects that will be discussed, including specification and design philosophy, are given below. The programme will begin with an introductory lecture by F. H. S. Brown, Deputy Chairman, Central Electricity Generating Board, U.K.

(i) System design, control and protection

(ii) Reactive-power compensation—methods and equipment, including synchronous compensators, shunt and series capacitors and shunt reactors

(iii) Power transformers

(iv) Indoor and outdoor substations and circuit-breakers

(v) Insulators, bushings and instrument transformers.

The printed material for the conference will take the form of short contributions varying from 1,500 to 4,000 words, depending on the subject matter. It is proposed to hold a small scientific exhibition as part of the conference.

Further details and registration forms will be available in due course from the Secretary, The Institution of Electrial Engineers, Savoy Place, London, W.C. 2.

BOOK ACKNOWLEDGMENTS

1. **Railway Engineering.** S. C. Rangwala. *Charotar Book Stall,* Anand. Rs. 10.00, 1964, 272 pages.

This book aims at presenting to the student the fundamental principles of railway engineering keeping in view the prevailing Indian practice. Equivalent metric dimensions are given alongside the dimensions in the British system. A number of self-explanatory diagrams and worked out examples are also contained in the book.

2. **The Fundamental Principles of Surveying and Levelling.** Prof. R. M. Khetani and R. C. Bhavsar. *Published by Prof. R. M. Khetani & Sons, Vallabh Vidyanagar,* Kaira. Rs. 12.50, 1961, 428 pages.

This book is intended to meet the needs of first year degree and first and second year diploma students of the Technical Boards in India. Several solved problems are given in the book.

3. **Estimating and Costing.** B. N. Dutta. *Published by the Author,* Tagore Palli, Motilal Bose Road, Lucknow. Rs. 14.00, 1963, 584 pages.

Intended to serve as a reference book for practising engineers and architects, this book deals with the theory and practice in estimating and costing and related topics. Besides, the book contains practical data, charts and tables of utility. This fifth edition book has been revised and enlarged. Stress is given on metric system, and a number of illustrations and conversion tables have been added.

peasantry, beginning with the Kisan Agitation in Eastern U.P. In 1921 came the first of the many occasions on which he courted arrest by refusing to obey orders he considered unjust.

In 1923 he was arrested for disobeying orders to leave the then State of Nabha. Thus began his special association with the freedom struggle in the Indian States.

In 1927 began his long association with international democratic movements with his participation in the Congress of Oppressed Nationalities in Brussels as an official delegate of the Indian National Congress, which he followed up with an extensive tour of Europe and his first visit to the U.S.S.R.

In 1929 he was elected President of the Lahore Session of the Indian National Congress. The national struggle entered a new and significant phase when on the sacred banks of the Ravi the Congress took the pledge on the historic day of December 31, 1929, of complete independence as its goal.

The thirties saw Jawaharlal Nehru become the acknowledged heir to Mahatma Gandhi. In between recurrent spells of incarceration and despite his preoccupations with national problems he found time also to participate in the struggle against the onslaughts of fascism in different parts of the world. He lent courageous support to the Republican forces in Spain and visited that country during turbulent days. His was one of the resounding voices in the years preceding the holocaust of the Second World War, warning the democratic forces all over the world against its coming menace.

The failure of the then Government of India to give the Indian people a meaningful opportunity to participate in the world struggle against fascism inexorably led to a conflict. The historic 'Quit India' Resolution was passed by the All-India Congress Committee at Bombay on August 9, 1942, and immediately thereafter Mahatma Gandhi, Jawaharlal Nehru and other leaders were imprisoned.

On their release three years later, negotiations with the British Government began and Jawaharlal Nehru took office as Vice-President of the Executive Council when the Interim Government of India was formed on September 2, 1946. The Constituent Assembly met on December 9 of the same year. Events followed in rapid succession leading to the partition of India. On August 15, 1947, India and Pakistan came into being as two separate countries.

On that solemn midnight when India became free Jawaharlal Nehru declared 'Long years ago we made a tryst with destiny, and now the time comes when we shall redeem our pledge, not wholly or in full measure but very substantially.' 'To the people of India, whose representatives we are, we make an appeal to join us with faith and confidence in this great adventure. We have to build the noble mansion of a free India where all her children may dwell.' In these seventeen years he had to bear many grievous shocks and none greater than the assassination of the Father of the Nation on January 30, 1948. Jawaharlal Nehru rallied the nation. 'A great disaster is a symbol to us to remember all the big things of life and forget the small things of which we have thought too much.' As the years passed Jawarlal Nehru lost many a trusted lieutenant and comrade in arms; undeterred he strove to build the India of his dreams.

His world vision remained undimmed. He convened the Asian Relations Conference in March 1947, and was its moving spirit. In 1954 he enunciated the *Panch Shila*, the five principles of peaceful co-existence. There were other international conferences leading to the Bandung Conference in 1955. He gave the world the doctrine of of non-alignment which was affirmed at the summit meeting of the non-aligned nations in Belgrade in 1961.

Jawaharlal Nehru was dedicated to the ideals of the United Nations and the principles of the Charter. He addressed the Third General Assembly Session in Paris in 1948. His last appearance at the United Nations was in 1960. There he moved a significant resolution stressing the need for world peace and urging the leaders of the great powers to renew their contacts. He was the first Head of Government to support the partial-test-ban pact signed by the three Nuclear Powers in August 1963.

He strove tirelessly against war and for total disarmament. He initiated and supported action for the liberation of dependent countries. He fought against the exploitation of man by man and worked ceaselessly to bring freedom from fear and hunger not only to his own people but to the world at large. He set his face against all political and military blocks as the greatest impediments to world peace.

Not the least abiding of Jawaharlal Nehru's contributions was his concept of a revolution in our national economy through planning within a democratic framework. Even before India had attained freedom, he foresaw the need for economic planning and was instrumental in setting up the National Planning Committee under the aegis of the Indian National Congress as early as 1936. When freedom came, the earlier efforts bore fruit. The Planning Commission was set up and in 1951 India embarked upon her historic series of Five-Year Plans. The acceptance of economic planning as a way of life by many few free nations is an eloquent tribute to his basic social and economic thinking.

Jawaharlal Nehru was unremitting in his endeavour for the unity and solidarity of the Indian nation. He struggled ceaselessly to blend the different elements of our national life into an integrated social structure. He fought against all the barriers of caste, religion and language and for the uplift of the less privileged. He constantly affirmed the secular concept of our State as necessary for all sections of India which have found a permanent place in literature.

Jawaharlal Nehru was a distinguished man of letters. He utilized his spells in prison to write 'Autobiography', 'Letters from a Father to His Daughter' 'Glimpses of World History' and 'Discovery of India'.

Such was the man who led his country for so many decades and administered it so wisely for eighteen years—an upholder of the noble values of human life and the dignity of man.

There could be no finer epitaph for Jawaharlal Nehru than that which he himself suggested in a pensive mood, with characteristic humility—'If any people choose to think of me then, I should like them to say 'This was a man who with all his mind and heart loved India and the Indian people. And they, in turn, were indulgent to him and gave all their love most abundantly and extravagantly'.'

That loving memory the Indian people, and indeed the peoples of the world, will always cherish for Jawaharlal. For, as Rabindranath Tagore said, 'He had never fought shy of truth when it was dangerous nor made alliance with falsehood when it would be convenient'.

Shri Jawaharlal Nehru was Honorary Member of the Institution from January 21, 1948.

The following messege of condolence was sent from the Headquarters of the Institution to Shrimati Indira Gandhi, on the death of Shri Nehru.

'The Institution of Engineers (India) which had the honour of having on its Roll the late Pandit Jawaharlal Nehru as Honorary Member joins the mourners in this national calamity which has taken away India's greatest son and beloved Prime Minister. May his soul rest in peace and his cherished memory guide us to fulfil his mission yet unfinished.'

The condolence resolution adopted by the Committee of the Madhya Pradesh Centre, at their meeting held on June 4, 1964, read as :

'The members of the Madhya Pradesh Centre of the Institution of Engineers (India) place on record their deep sense of sorrow at the sudden demise of our revered Prime Minister, Pandit Jawaharlal Nehru. His contribution towards the cause of progress of science and technology has been unparalleled. In him the Institution of Engineers (India) has lost a good patron to whom the Institution always looked for guidance. The Madhya Pradesh Centre joins the nation in paying homage to his illustrious memory.'

A special general meeting of the members of the Mysore Centre was held on June 8, 1964, to condole the death of Shri Nehru. The condolence resolution passed at the above meeting is given below.

'This meeting of the members of the Institution of Engineers (India), Mysore Centre, place on record the deep sense of grief and irreparable loss caused by the passing away of Shri Jawaharlal Nehru, noblest son of India and Prime Minister since independence, and an Honorary Member of the Institution.

Shri Jawaharlal Nehru gave the engineers of this country abundant opportunities for work. During the last 17 years of independence under his stewardship, the country has seen outstanding engineering achievements in all fields of engineering, *viz.*, irrigation, power, bridges, industry, aircraft, automobile, railways, machine tools, electric machinery, metallurgical plants, chemical plants and many others—too numerous to mention.

His call for meeting the challenge of the jet age, the space age, atomic age, rallied round the engineers and technologists of the country inducing them to demonstrate the capabilities of Indian engineers. In the passing away of Shri Jawaharlal Nehru, the country has lost the dynamic leadership which helped so much to create a scientific and technological climate in the country which is so essential in a developing country like India.

On this occasion, we the members of the Institution of Engineers (India), re-dedicate ourselves to continue to meet the challenge in the building of the nation. As per his wish expressed on the occasion of his address to the members of the Institution we pledge to be the active agents in the tremendous technological revolution that is taking place in India. We pray that his noble soul may rest in peace.'

OBITUARY

Sir L. P. Misra

Sir Lakshmi Pati Misra, B.Sc., C.E., Dr. Eng., died in Calcutta on February 8, 1964, at the age of 76. He was President of the Institution for 1942-43.

Born in 1888 at Mainpuri in Uttar Pradesh, Sir Lakshmi Pati obtained the B.Sc. degree of the Allahabad University in 1907 and obtained his engineering degree from the Thomason College of Engineering, Roorkee, in 1911. He joined the Indian Service of Engineers in 1912 and worked as Executive Engineer in the Indian State Railways. He served in various capacities in the former East India and North-Western Railways, including three years as Deputy General Manager, East Indian Railway, and was General Manager, East Bengal Railway and Bengal Assam Railway from 1939 to 1943.

In 1938-39, he was a member of the Federal Public Service Commission, Government of India, and from 1939 to 1943, a Commissioner for the Port of Calcutta. He was Member (Engineering) of the Railway Board in 1943-44 and Chief Commissioner of Railways in 1945. In 1946, he joined the Hindustan Motors Ltd., Calcutta, as General Manager.

He was knighted in 1944. In 1959, he received an Honorary Doctorate of Engineering from the Roorkee University.

Sir Lakshmi Pati was President of the Indian branch of the Institute of Welding London in 1949-52, and of the Indian Roads & Transport Development Ltd.'s Calcutta branch since 1960. He was Chairman of the Central Machine Tool Panel in 1948-49 ; Workshops Coordination and Development Committee, Uttar Pradesh in 1950-51 ; Advisory Committee, Indian Standards Institution's Calcutta unit since 1956 ; and the Association of Automobile Manufacturers since March 1961. Besides these engineering activities, he was Commandant of the Calcutta Special Constabulary in 1950, and was a well-known and familiar figure in Indian tennis.

He had been a member of a large number of official and non-official organizations, including the Automobile Export Committee (1950-51) ; the National Railway Users' Consultative Council (1953) ; the Advisory Panel at Calcutta for the Central Board of Film Censors (1951-56); the Railway Equipment Committee (1955-56) ; and the Road and Inland Water Transport Committee (1956-1958).

Sir Lakshmi Pati Misra joined the Institution as Member in 1925, and became its President in 1942-43.

Shri B. R. Manickam

Shri B. R. Manickam, B.E., M.S., M.ASCE, F.I.T.P., M.I.E., son of the late Raju Mudaliar of Bangalore, was born in the year 1909. He died on May 31, 1964, at the age of 55 at Vellore, after a sudden illness.

After a brilliant scholastic career, Shri Manickam took his Bachelor of Engineering degree with a first class from the Government Engineering College, Bangalore, in the year 1930. Soon after his graduation, he was appointed Class I Officer (Gazetted Engineer) in the Public Works Department. He was deputed to the U.S.A. in the year 1947-48 where he secured with merit the Master of Science degree in Architecture and Town Planning, from the Illinois Institute of Technology, Chicago. On his return, he was appointed as Government Architect and Town Planning Officer in 1949. In 1955, he become Superintending Engineer, and in 1959, he was appointed as the Director of Town Planning and later, as Chief Engineer, Communications and Buildings, in February 1961. He held this post till his retirement in April 1964. He was also an Architectural Consultant for many institutions like the Indian Institute of Science, the Bank of Mysore, the Central Food Technological Research Institute at Mysore, the University of Mysore, etc. He served the Public Works Department of the State for over 30 years. He was responsible for many large public buildings in Mysore and Madras in regard to their planning and architecture. A few among his outstanding works are the Vidhana Soudha and the Ravindra Kalakshetra in Bangalore, the Stadium adjacent to the Bangalore Corporation Buildings, the Hubli Medical College, the Indian Institute of Science at Bangalore, and the Mysore Bank Building at Madras.

Shri Manickam's yeomen services to the Institution and the erstwhile Mysore Engineers' Association require special mention. Shri Manickam was the President of the Mysore Engineers' Association for three years and its last President, and it was his untiring efforts that were chiefly responsible for the merger of this Association with the Institution, to mark which a function was held in the new building of the Mysore Centre of the Institution on 24th May this year.

Shri Manickam was elected Chairman of the Mysore Centre for three consecutive years, *viz.*, 1961-62, 1962-63 and 1963-64, in recognition of his services. The imposing building of the Mysore Centre which was declared open by Dr. K. L. Rao, on May 24, 1964, was made possible almost entirely due to the personal efforts of Shri Manickam. In addition to securing a beautiful site and a sizeable grant from the Government of Mysore, he helped to raise funds to the extent of Rs. 1,30,000 from engineering firms and contractors.

Dr. K. L. Rao, Union Minister for Irrigation and Power, while unveiling the portrait of Shri Manickam on 24th May in Bangalore on the occasion of the amalgamation of the Mysore Engineers' Association with the Institution, eulogised his services for the benefit of the State and the country as a whole.

In the death of Shri Manickam, the Institution has lost a dynamic and lovable personality.

He joined the Institution as Associate Member in 1950 and was transferred to Member in 1960.

A special meeting of the Executive Committee of the Mysore Centre and also a special general meeting of the members of that Centre were held on June 4, 1964, to condole the death of Shri Manickam. The condolence resolution passed at the above meeting is given below.

'The Members of the Executive Committee of the Institution of Engineers (India), Mysore Centre, deeply mourn the sad demise of Shri B. R. Manickam, Chairman of our Centre and the last President of the Mysore Engineers' Association, and retired Chief Engineer, Director of Town Planning, and Government Architect, Government of Mysore, on Sunday, May 31, 1964, at Vellore.

In his sad demise, the Institution, specially the Local Centre, has lost a dynamic and lovable personality. As an energetic and enthusiastic steward at the helm of its affairs, he was responsible for several significant events such as the completion of the Institution building and the amalgamation of the Mysore Engineers' Association with the Institution of Engineers (India).

Resolved to convey our heartfelt condolences to the members of the bereaved family. May his soul rest in peace.'

A condolence message dated June 3, 1964, received from Dr. K. L. Rao, Minister for Irrigation and Power, Government of India, reads as :

'I am deeply shocked to hear of the sudden demise of Shri B. R. Manickam at such an early age, with still so much promise in it.

Shri Manickam was one of the foremost engineer-architects of India, and the Vidhana Soudha at Bangalore will stand as a lasting monument to his genius. His pioneering and dynamic efforts introduced town planning as a specialized activity and finally a department on a level with the P.W.D. in Mysore. There are many such examples in the life of Shri Manickam which other States can emulate with benefit.

It was also Shri Manickam's deep sense of unity and nationalism that forged the amalgamation of the Mysore Engineers' Association with the Institution of Engineers (India) recently, the Mysore Centre building of which I had the privilege to inaugurate in Bangalore only last month. With Shri Manickam as the Chairman of the Mysore Centre, the Centre could have looked forward to a period of rapid growth and considerable activity in the field of engineering in Mysore State. The death of Shri Manickam is a great loss to Mysore and to the field of architectural engineering in India. The best tribute to the memory of Shri Manickam would be to carry forward the traditions he set up and emulate the eventful life he led with so much distinction.

I shall be grateful if you will kindly convey my heartfelt condolences to the bereaved family of Shri Manickam.'

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from Bulletin for May 1964)

STUDENTS

No.	Name
43324	Augustine Mendelssohn Lazarus
43325	Srinivasavaradha Narayanan
43326	T. Alagar
43327	S. Kesavan
43328	Wilfred Barreto
43329	Dorairajan Natarajan
43330	A. V. Lenin Mohan Roy
43331	M. C. Eapen
43332	Vedarama Subramanian
43333	Othayamangalath Haridasan Nair
43334	Krishnamurthy Govindarajan
43335	Putty Srinivasarao Prabhakar
43336	Valadi Seetharaman Sundararajan
43337	Ramakrishnaiyer Sankaralingam
43338	Olekngil Mathew Babu George
43339	Chokkanahalli Prahalada Rao
43340	Mohindra Nath Kushary
43341	Heti Radhakrishna Mohanmurali
43342	Jayanti Lakshminarayana
43343	Kasthuri Damodaran
43344	Albert Decruz
43345	Lakshminarayana Rajappan
43346	Nellacheruvu Venkata Subrahmanya Sastry
43347	Hariappan Balasubramanian
43348	Narasingapuram Ranganathan
43349	Muthukrishnan Radhakrishnan
43350	Shanti Narain Chawla
43351	Tirumalai Vedantham Srinivasan
43352	Jampala Kesava Rao
43353	Sankaranarayanan Venkatakrishnan
43354	Venkatraman Balasubramanian
43355	Valkodai Ramanathan Chandrasekharan
43356	Thiravianadar Selvarajan
43357	Ramaraju Chondru Rama Rao
43358	A. K. Soundararajan
43359	Natarajan Sridharan
43360	Krishnaiyer Gopalan
43361	Rameswamygounder Kulandaivelu
43362	S. Krishnamurthy
43363	Vaidhyanatha Srinivasan
43364	Vamana Rao
43365	Lourdusamy Thomas Albert
43366	Comalrajagopala Ratnam Venkataramanan
43367	Ranganathan Balasubramaniam
43368	Yesudian Victor
43369	Krishnaswamy Rajaram
43370	K. G. Balasubramaniyan
43371	Thirutheri Gopalasamy Sampath Raghavan
43372	Valeeswaran Sugavanam
43373	Parasa Mukharji Rao
43374	T. Krishnamurthy
43375	Mogili Raja Kumar Reddy
43376	Cunnathoor Vajravadivelu Rajavadivelu
43377	P. Subramanian
43378	Rajam Ramamurthy
43379	G. V. Subrahmanya Kali Vara Prasad Rao
43380	Jasti Seshagiri Rao
43381	Gotta Venkatta Ratnam
43382	Yalamanchili Chakradhara Rao
43383	Govindapillai Ramachandra Pillai
43384	Vallabhaneni Pitchaiah
43385	N. S. Muralidhara Rao
43386	R. Ramachandran
43387	Damal Pathangi Kannan
43388	Balasubramaniam Nagarajan
43389	N. Gnanam
43390	Ramanagouda Shankargouda Patil
43391	Krishnaiyer Sundara Rajan
43392	C. S. Chandrasekharan Nair
43393	P. Vijayan
43394	Thuraiyur Narayanaswamy Venugopalan
43395	Thirumalai Eachambadi Venugopalan
43396	A. Ramathan
43397	Rameswamy Kasiviswanathan
43398	Penmatcha Ramkrishna Raju
43399	Aloysius Joseph Menezes
43400	Gundloor Amin Peer
43401	Kalyan Kumar Kar
43402	Bidyut Kumar Raha
43403	Adityakumar Majumdar
43404	Subbaramaiyer Krishnamurthy
43405	Ashim Kumar Ghosh
43406	Bharat Bhusan Biswas

STUDENTS—(*contd.*)

No.	Name
43407	Prabir Kumar Chakraberti
43408	Sachinandan Goswami
43409	Sambhudas Bandyopadhyay
43410	N. Venkataramaiah Narayanaswamy
43411	O. Krishnaswamy
43412	P. J. John
43413	Mohanavelu Gopu
43414	Kunnummalveetil Gangadharan Nair
43415	Gaddam Thiruvenkatachari
43416	M. Sundaram
43417	Samir Kumar Sur
43418	Kannimangalam Vaidyanathan Krishnamurthy
43419	Ajit Kumar Deb
43420	Pradyot Kumar Mitra
43421	Jibananda Ghose
43422	K. Covilakam Prabhakaranunni Vallody
43423	Bijan Kumar Basu
43424	Arabinda Ray
43425	Ram Das Pande
43426	Kanniahchettiar Perumal
43427	Rajaniyengar Rengarajan
43428	Rama Kant Singh
43429	Pratul Bandyopadhyay
43430	K. Raman
43431	R. Subba Reddy
43432	Malleda Balakrishna Prasad
43433	Unniyur Senniappan Subramanian
43434	K. M. Xavier James
43435	R. Balasubramanian
43436	Mannvanchariparambathu Mathew Poulose
43437	K. R. Bashyam
43438	Gangatharan Vasudevan
43439	Srinivasa Vasudevan
43440	Coimbatore Subramaniam Krishnan
43441	Kantilal Chandulal Davey
43442	Renganathan Jagannathan
43443	Saggere Vijayadri
43444	Kalyanasundaram
43445	Kameswaran Sankaran
43446	Rangaswamy Desikan
43447	Guddalur Subramaniam Gopalakrishnan
43448	P. Pauliah Wadar
43449	Chinnaswami Ponnar
43450	N. Ammi Reddy

No.	Name
43451	K. Lakshmi Narasimha Rao
43452	Nagamanikkam Nagarajan
43453	Sankaranarayana Rangasamy
43454	Madhava Bala Krishna Warrior
43455	Saladagu Rajendra Chetty
43456	Ramanuja Krishnamachari
43457	T. Mallikarjunan
43458	Sirunugai Amir Abdul Ghani
43459	Deivasigamani Sampath
43460	Inna Krishna Bhat
43461	Parkash Singh
43462	Kolinjivadi Subramaniam Krishnamoorthi
43463	Sivaramakrishna Narasimhan
43464	Vaiyakaranam Krishnamurthy
43465	Madurantakam Kuppuswamy Srinivasan
43466	Balu Vasudevan
43467	K. Karuppagounder Palaniswamy
43468	T. R. Nagarajan
43469	Puliyadi K. Subramaniyam
43470	S. Velayudham Pillai
43471	Cherukuri Kanakacharyulu
43472	James Ratnaraj
43473	K. Balan Natarajan
43474	Kalyana Sundaram Sivagnanam
43475	Natesan Velu
43476	S. Janakiraman
43477	V. S. Jayaramasubramaniam
43478	Atravanam Varaha Padmanabha Rao
43479	C. Sundaravaradam Parthasarathy
43480	M. Madhavan Adiyodi
43481	Karumanchy Venkata Radhakrishna Dass
43482	Melur Vedagiri Varadarajan
43483	Gingee Vijaya Raghu
43484	M. A. Varadarajan
43485	Ram Gopal Dutt
43486	P. Velayudhan Narayana Pillai
43487	Rajo Singh
43488	Vadakkam Thomas Louis
43489	G. Rangaswami Srinivasan
43490	Gorti Satyanarayana Murty
43491	Srinivasan Govindan
43492	P. S. Govinda Subbu
43493	Ramachandra Krishnamoorthy Raju
43494	K. S. Jayapal
43495	Parthasarathy Satagopan

STUDENTS—(*contd.*)

No.	Name
43496	Venkatasubramaniam Venkataraman
43497	Narayanasamychettiar Padmanaban
43498	Doraiswami Srinivasan
43499	Kasthuriranga Govindarajulu Venkatesan
43500	Amar Singh
43501	Ramaswamy Narayanan
43502	Pulavarthy Murali Mohana Krishna
43503	P. Raju
43504	Thirumazhisai Sudarsanachari Rangarajan
43505	Theertha Swaminatha Theerthanarayanan
43506	Srinivasa Pichai
43507	A. Perianayagasami
43508	Nuggehalli Ramanna Seshadri
43509	Sham Sunder
43510	S. Lakshmi Raghavan
43511	M. Sivaramakrishnan Nageswaran
43512	R. Sivaramakrishnan
43513	Shanmugam Muthukumaraswami
43514	Rajagopalan Srinivasan
43515	Kanniah Srinivasan
43516	Heeramanlal Mothilal
43517	V. Ramachandran
43518	Padmanabhan Swaminathan
43519	Pennagaram Chowrirajan Narayanan
43520	Narasimha Narayanan
43521	K. Narayanan
43522	R. Seetharaman
43523	Tanjore Krishnamoorthy Srinivasan
43524	C. S. Mahadevan
43525	P. Sivasubramaniam
43526	Subbaroya Mudaliar Palani
43527	Venkatarama Gopalan
43528	Ponnanpillai Sethumadhavan
43529	Nallkara Joseph Albert
43530	P. Ramesh
43531	Salvankuppam Ethirajalu Manivannan
43532	Sreenivasan Venkatakrishnan
43533	Thanthullu Kuppusamy Sundaramoorthy
43534	R. Venkatasubramanian
43535	Bommakanti Ramkrishna Suryaram
43536	Polamuri Sundara Rao
43537	Subramaniam Viswanathan
43538	R. Sivaraman
43539	Abdul Hayum
43540	Asok Chandra Misra
43541	A. R. Ramachandran
43542	C. Thirunavukkarasu Chandrasekaran
43543	Sanjeevappa Narayana
43544	Chelliah Sundararaj
43545	Rajagopal Raghavan
43546	Manickam Subramaniam Shunmugham
43547	Brundaban Jena
43548	Philip Abraham
43549	Krishnaswami Jayaraman
43550	Mohan Gharpure
43551	Aggibothu Chinniah Ranganatha
43552	Subramanian Venkateswaran
43553	Gopalakurup Ram Mohan
43554	Parameswaraiyer Balasubramaniam
43555	T. V. S. P. Ragavendra Rao
43556	Ammersahib Mohamed Jaffar
43557	Swaminathan Kandaswamy Kalaiperumal
43558	Doothireddi Purushotham Reddy
43559	Sivasubramaniyam Nadimuthu
43560	Ramachandran Venkata Subramanian
43561	Chingleput Vedachalam Sadanandam
43562	P. J. John
43563	Ramaswami Venkata Narayanan
43564	C. Parthasarathy Raja Gopal
43565	Chevendra Balakrishna Rao
43566	J. Mathew Kavalam
43567	Keesara Harender Reddy
43568	N. Bhooshana Kadamba
43569	Kaza Nageswara Prasad
43570	Asadulasheriff Salar Sheriff
43571	Putta Rama Rao
43572	Vallamsetla Venkateswara Rao
43573	Kambhammettu Sreehari Rao
43574	Ramaswamy Muthusamy
43575	Vutha Arunachalam Ramaswamy
43576	Krishnamoorthy Sethuganesan
43577	Perumal Srinivasan
43578	Narayanaswamy Srinivasan
43579	Ashok Kumar Mohan
43580	M. V. John
43581	Michael Anthony
43582	Reddi Mavullayya
43583	Sundaresan Ramaswamy
43584	S. Sundararajan
43585	Om Prakash Narayan

STUDENTS—(*contd.*)

No.	Name
43586	T. P. Umashanker
43587	R. Nagarajan
43588	Karaparambil Imamkhan Abdul Sammed Khan
43589	B. Narasimhan
43590	Ramasubbiar Rajagopalan
43591	C. Natarajan
43592	Kotagiri Jagan Mohan Rao
43593	Vaydhyanathan Janardhanan
43594	Kalanji Seetharama Moorthy
43595	R. Vijaya Varma
43596	B. Pushpavanam
43597	R. Javaharlal
43598	Tanjore Narasingarao Narayana Rao
43599	P. Natarajan
43600	Krishnaswamy Uthama Gopalakrishnan
43601	Sumonto Mohanty
43602	D. Chellam
43603	Kuppuswamy Rajasekaran
43604	Rajagopalan Ramaswamy
43605	Krishnamurthy Venkataraman
43606	Saumitri Rana
43607	Brundaban Sahu
43608	Krishnarao Raghunath
43609	Sivasangu Suruli
43610	P. H. Ramachandran
43611	Villianallore Muthuswamy Ramamoorthy
43612	Vilasam Thankappan Pillai
43613	Ganesan Ramasubramaniam
43614	Padmanabhan Gopal
43615	Baskaraswamy Rajasekharan
43616	Puduppakkam Hudumbai Rajagopalan
43617	Vallioor S. Sundara Krishnan
43618	Namburi Radha Krishna
43619	Ealajoorao Dadava Rao
43620	Ganapathyiyer Viswanathan Iyer
43621	Benjamin Douglas Singh
43622	Koottala Ananthaiyer Subramaniam
43623	A. N. Soman
43624	Kanniahnaidu Munirathinam
43625	Toodhbhatha Lakshmanrao Kasinath Rao
43626	Padmanabhapillai Thankappan Pillai
43627	Rajarathinam Lakshmipathi
43628	Mohammed Musar
43629	Rameswamiayyar Natarajan
43630	K. P. Padmanabhan
43631	Muthuswamyiyer Venkataraman
43632	Villivalam Desikachariar Narayanan
43633	Pandarigowder Palanichamy
43634	Govindarajalu Jayaraman
43635	Subbiahnaidu Sankarasubbu
43636	Vellore Chandrasekara Rao
43637	Alagarsamy Govindaraj
43638	Arumugasamynadar Natarajan
43639	Guruswamy Vadivelu
43640	C. Lakshmavadhani
43641	C. V. George
43642	S. Madhavan
43643	C. Y. Ummunny
43644	Venkataraman Seetharaman
43645	K. Alakar Raja
43646	Vaidyanatha Venkatachalam
43647	Machinary Puthanapurayil Narayanan
43648	Gajula Hanumanthaiah
43649	N. G. Soman
43650	S. Lakshmanan
43651	Prathivathi Bhayankaram Sampath
43652	T. Vaithianathan
43653	A. Ananthakrishnan
43654	Narayanabhatla Syamasundar
43655	M. M. Cherian
43656	Swaminatha Krishnamoorthy
43657	Asoori Vanamali
43658	Ramanathan Srinivasan
43659	Francis Xavier Royan
43660	Kothandaraman Srinivasan Srinivasan
43661	Mahadanapuram Ramachandran Sivaswamy
43662	G. Muthiah
43663	Mylai Natarajamudaliar Ramanathan
43664	Pandurangam Murahari
43665	Subramania Gopalakrishnan
43666	S. Ambalavanan
43667	Valeeswaran Sugavanam
43668	A. Palaniappan
43669	Subrata Sinha
43670	Satyanarayan Chaudhuri
43671	Vishwanath Verma
43672	Krishnaiyer Viswanathan
43673	Asok Kumar Basu

STUDENTS—(*contd.*)

No.	Name	No.	Name
43674	C. R. Kunjayyappan	43719	Krishan Lal Ahuja
43675	B. Peter Sorniah Demel	43720	Prem Prakash
43676	Krishnaiyar Thulasiraman	43721	Chetan Prakash Mathur
43677	K. Vasanth Upadhyaya	43722	Santosh Dutta Roy
43678	Iyyaswamy Kalyanasundaram	43723	Triloki Nath Verma
43679	Vanta Subrahmanyam Dwarakanath	43724	Darbari Lal
43680	Subramaniam Vankataraman	43725	Pyara Lal Mukoo
43681	Tirupati Komandoor Srinivasan	43726	Krishan Chand
43682	Soundappachettiar Marimuthu	43727	Purushottam
43683	Narayanaiyer Rajamony	43728	Veerendra Kumar Jain
43684	Subbiyer Mallikarjunan	43729	Krishna Gopal Ray
43685	Lakshmana Ramamoorthy	43730	Madhusudan Parshuram Tathavadekar
43686	P. Narasimhulu	43731	G. Susmidharan Nair
43687	Govindarao Sudarshana	43732	Ajit Kumar
43688	K. P. Ramachandran Nair	43733	Onkar Nath Anand
43689	Umesh Kumar Jain	43734	Raj Narain Kapoor
43690	Shyam Sundar Banik	43735	Suwalal Khivraj Dugad
43691	Seshachar Raghavendrachar	43736	Raj Kumar Grover
43692	Vijay Kumar Kamboj	43737	Radhey Shyam Mishra
43693	Manabbendra Kumar Sen	43738	Sat Pall
43694	Tapan Kumar Majumdar	43739	Krishan Dev
43695	Sankar Das Gupta	43740	Kaippallil Ravindran
43696	Dhirendra Nath Adhikari	43741	Madhukar Shripatrao Pise
43697	Ranjit Kumar Banerjee	43742	Swami Dayal Bhatia
43698	Prodosh Ranjan Das	43743	Bansi Lal Khushoo
43699	Ashok Kumar Vohra	43744	Anant Pandurang Deshpande
43700	Nityagopal Majumdar	43745	Bhirgu Saran Shukla
43701	Suhas Chandra Basu	43746	Balwant Singh Saini
43702	Binod Bihari Jana	43747	Rameshwar Dayal
43703	Sailendra Kumar Chakrabarti	43748	Narendra Kumar Rastogi
43704	Parmeshwar Dayal Singhal	43749	Mohan Ji Dhar
43705	Tapaskumar Chattopadhyay	43750	Satish Kumar Gupta
43706	Shriniwas Purushottam Manakar	43751	Arjun Chotandas Chandnani
43707	Shri Pal Jain	43752	Mahesh Chandra Sharma
43708	Padam Narayan Mathur	43753	Ram Gopal Mahawal
43709	Chandra Prakash Gupta	43754	Umesh Kumar Anand
43710	Romesh Kumar Marwaha	43755	Shanker Lal Suthar
43711	Des Raj Sharma	43756	Rushen Lal Wali
43712	Kishen Lal Kaul	43757	K. V. Manjanatha
43713	Susantanath Sarkar	43758	Prabodh Muktilal Kothari
43714	Satnam Singh Sanehi	43759	Kailash Lall
43715	Surendra Kumar Verma	43760	T. R. Aswathanarayana Gupta
43716	Ram Chandra	43761	Shamrao Balvant Patil
43717	Dharmendra Prasad Gupta	43762	Prabhakar Vishnupant Deo
43718	Autar Krishan Koula	43763	Ved Perkash Sharma

STUDENTS—(contd.)

No.	Name
43764	Suresh Kumar Mehta
43765	Mahavir Singh
43766	Hiralal Mukhopadhyay
43767	Shree Kant Joshi
43768	Mani Ram
43769	Naresh Chander Sehgal
43770	Nirmal Mirchandani
43771	Shyamal Kumar Basu
43772	Amar Nath Kaushal
43773	Milan Sen
43774	Susanta Kumar Ray
43775	Vinod Prakash Agrawal
43776	Nilay Kumar De
43777	Dipak Lal Chakrabarti
43778	Nitai Chandra Mitra
43779	Ramesh Chandra Marwari
43780	Vijay Kumar Bhatia
43781	Madan Gopal Kokra
43782	Sachin Kumar Sengupta
43783	Manoj Kumar Mukhopadhyay
43784	Samar Dey
43785	Shyamal Kumar Basu
43786	Jasomay Majumdar
43787	Pabitra Kumar Roy Chowdhury
43788	Sukumar Chaudhuri
43789	Debdas Bhattacharyya
43790	Asok Kumar Mazumdar
43791	Satya Narayan Basu
43792	Samarendra Nath Majumdar
43793	Mihir Kumar Basak
43794	Saritsekhar Bagchi
43795	Rabindra Nath Das
43796	Kishore Lal Mathur
43797	Bashiruddin
43798	Sudarshan Kumar Salwan
43799	Narendra Sharma
43800	Prabhakar Agwekar
43801	Doddiganahally Sitharam Chandrasekhara
43802	Ved Parkash Khanna
43803	Kamalakanta Supakar
43804	Biswanath Chattopadhyay
43805	Santosh Kumar Chakrabarti
43806	Nilratan Bhattacharya
43807	Jayant Govind Kale
43808	Vasudevakurup Rama Chandra Kurup
43809	Kamal Jeet Singh
43810	Shyama Prasad Bose
43811	Guru Saday Ghosh
43812	Chitta Binod Datta
43813	Subodhkumar Roy
43814	Sankar Kumar Roy Chaudhuri
43815	Tarachand Datta
43816	Shyama Pada Hui
43817	Arun Kumar Basu
43818	Anandamoy Bandyopadhyay
43819	Sib Chandra Bandyopadhyay
43820	Vinod Kumar Chawla
43821	Vasudeo Ramchandra Kench
43822	Subhash Sinha
43823	Harbhajansingh Bahadursingh Phull
43824	Singaraju Sreerama Chandramurthy
43825	Swapan Chatterjee
43826	Sunil Baran Mukhopadhyay
43827	Prodyot Kumar Chattopadhayay
43828	Prabir Kumar Ghosh
43829	Shripad Purushottam Kale
43830	Gauri Shanker Tiwari
43831	Arun Kumar Basu
43832	Sharadchandra Gopalrao Kulkarni
43833	Madanmohan Mandal
43834	Saktipada Pan
43835	Pradip Kumar Sinha
43836	Subrata Dutta
43837	Susanta Kumar Ghosh
43838	Abdul Hakeem
43839	Ramasamy Ananthasayanam
43840	Raghunath Masaji Ghatage
43841	Subhash Vinayak Bhide
43842	Dipakkumar Mitra
43843	Yasada Kumar Bhowmik
43844	Yogendra Kumar Gupta
43845	Chhotey Lal
43846	Brijendra Kumar Saxena
43847	Podury Krishnamurty
43848	Mulkad Krishnarayaprabhu Sripathi
43849	Gulshan Lal Jaggi
43850	Janardan Gangadhar Inamdar
43851	Yogendra Prakash Rajput
43852	Nityaranjan Chakrabarti
43853	Krishnadas Chatterjee

STUDENTS—(*contd.*)

No.	Name
43854	Shyam Lal Daga
43855	Prem Chand
43856	Vishwanath Maruti Unkule
43857	Sukhpal Singh
43858	Rajendra Nath Goel
43859	Debaprasad Nath
43860	Dilip Kumar Mitra
43861	Shrikrishna Purushottam Abhyankar
43862	Sadhanala Lakshmana Rao
43863	Krishnaiyer Balasubramaniam
43864	Anil Kumar Gupta
43865	Shri Niwas Sharma
43866	Prem Datta Sharma
43867	Dagadushet Dattatraya Kajale
43868	Hem Raj Khurana
43869	Shashikant Shantaram Kakade
43870	Gur Charan Singh
43871	Suresh Chandra Gupta
43872	Jagdish Chandra Dhondiyal
43873	Subhashchandra Ravaji Doshi
43874	Surendra Kumar Sethi
43875	Anant Sharad Phadke
43876	Karan Deep Singh Suri
43877	Harish Chander Satyedev
43878	Om Parkash Gupta
43879	Kailash Nath Gupta
43880	Purushottam Sitaram Kulkarni
43881	Ramesh Kumar Myer
43882	Yuv Raj Krishna Misra
43883	Digamber Laxman Jabade
43884	Jagdish Sahai Sharma
43885	John D. Souza
43886	Brahma Din
43887	Deep Chandra Tewary
43888	Arwind Madhav Karwoor
43889	Ramashetty Rachappa Balkery
43890	Dattatraya Rangnath Sarolkar
43891	Asokan anda Ray
43892	Pralay Ranjan Sen
43893	Ramdas Baburao Chaudhari
43894	Prakash Ramchandra Puranik
43895	Vidya Bhushan Sharma
43896	Ram Gopal
43897	Krishna Swarup Saxena
43898	Amar Singh
43899	Devki Nand Dhingra
43900	Vishnu Rangnath Daithankar
43901	Basant Kumar Saxena
43902	Suresh Chandra Gautam
43903	Daya Ram
43904	Hebbur Narasappa Ramanna
43905	K. G. Thomas
43906	Sunil Kumar Saha
43907	M. H. Shankara
43908	Awdhesh Kumar Sharma
43909	Sanjib Kumar Sarkar
43910	Amal Kumar Basu
43911	Nirmal Kumar Pal
43912	Syed Nurul Huda
43913	Tapan Kumar Das
43914	Samar Chatterjee
43915	Sujan Kumar Kar
43916	Palanilkunnathil Varughese John
43917	Satindu Sekhar Lahiri
43918	Nilkanth Gopal Parasnis
43919	Mohamed Gafoor U. R. Rahman
43920	Prasannakumar Ganesh Ghate
43921	Debdas Gangopadhyay
43922	Amarendrachandra Ray
43923	Suresh Anant Dandekar
43924	Suresh Ganpatrao Nikate
43925	Aroon Sadashivrao Mainkar
43926	Ashok Shridhar Godbole
43927	Arvind Shankar Joshi
43928	Chaman Lal Kanwal
43929	Ramakant Dattatray Kshirsagar
43930	Bhikhubhai Lallubhai Patel
43931	Shibendra Nath Mitra
43932	Pandharinath Atmaram Mhaskar
43933	Shripad Shankar Chilakwad
43934	Vijaykumar Sadashiv Apte
43935	Tarun Sarkar
43936	Nirmal Kumar Dutta
43937	Kaustubhakanta Goswami
43938	Satyabrata Misra
43939	Ajoy Chandra Das Gupta
43940	Biswarup Mitra
43941	Gobinda Bhattacharyya
43942	Manik Chandra Kundu
43943	Sharad Gopal Pethe

STUDENTS—(*contd.*)

No.	Name
43944	K. Krishnayya Hebbar
43945	Karuthakunju Kavirajan
43946	Rudrappa Veerappa Kumbar
43947	Bappur Shamsunder
43948	Narayanaswamy Madanan Gopalan
43949	Jayakanthi
43950	U. Venkat Rao
43951	Timir Baran Mahata
43952	Arehalli Chandrappa
43953	Anand Dattatraya Naik
43954	S. N. Gurumath
43955	J. Sampath Naik
43956	S. S. Range Gowda
43957	Ambaji Narayanrao Telkar
43958	Bhasmangadevaru Prabhu Devaru
43959	H. Srinivasa Iyengar Ramaswamy Iyengar
43960	T. Karanam Sankara Narayana Rao
43961	Hebbale Venkatanarayana Nagaraj
43962	Mehnga Singh
43963	H. G. Jaya Ram Reddy
43964	Pranab Kumar Gupta
43965	Ramachandraiya Gopala Krishna
43966	Thachambat Subramanyadixit Ramanathan
43967	Erapalli Devarajrow Sunder Raj
43968	Dasappasetty Prasannakumara
43969	Seenappa Venkataswamy
43970	Agara Ramarao Gopal Rao
43971	Poorigali Bhimarao Gururaj
43972	Zulfikhar Ali Mecci
43973	H. Mohamed Ilyas
43974	Bheemasenarao Satyanarayana Murthy
43975	Vijaykumar Krishna Deshpande
43976	Sudhakar Manoharrao Sangwikar
43977	S. R. Srinivasa Murthy
43978	Somenahalli Krishnamurthy Nagarajan
43979	Ratnagiri Gopalaiyengar Venkatarangan
43980	Aswathanarayanasastry Nagaraja
43981	Giriyappa Chanabasappa Namadararadder
43982	Kariyappa Mahadevappa
43983	Mosalkote Vasudevarao Gururaja Rao
43984	Pedamale Subrahmanya
43985	Aswathanarayanarao Sreenivasa Murthy
43986	Nadavathi Ramaiah Lakshmikantha
43987	Begoor Nagendradutta Viswanath
43988	Batni Narayana Rao
43989	Tumkur Gundurao Raja Rao
43990	Dalip Singh
43991	Krishnappa Nagaraja Rao
43992	Ramachandran Krishna Murthy
43993	Ramesh Chandra Dosad
43994	M. Parthasarathy
43995	Arun Madhusudan Apte
43996	Raj Kumar Rajput
43997	Sidheshwar Narhar Deolalkar
43998	Jayantilal Kevaldas Shah
43999	P. J. Krishna
44000	K. M. Nasir Ahmed
44001	Sushilkumar Vyankatesh Rajopadhye
44002	Ashok Wasudeorao Deshpande
44003	Kishan Lal Khurana
44004	Baldev Raj Devgan
44005	Raj Narain Gandhi
44006	Dhan Prakash
44007	Tirath Ram
44008	Venkatasubbaiah Srinivasan
44009	Somanathayya Shivashankarayya Hiremath
44010	Jagdish Chander
44011	Niranjan Pal Gupta
44012	Chander Parkash
44013	Nathi Ram
44014	Sadhu Ram Mor
44015	Bhupinder Singh Anand
44016	Satya Paul
44017	Jagdish Chander Buber
44018	Jawahar Lal Sharma
44019	Jagdishwar Singh Kandah
44020	Vijay Kumar Puri
44021	Sudesh Kumar Gupta
44022	Surinder Singh
44023	Jagdish Chander
44024	Balebail Srinivasa Dasannacharya
44025	Kailash Narain Srivastava
44026	Jogendra Nath
44027	Satish Chandra
44028	Subhash Chandra Chakraborty
44029	Hanumanahally Kallappa Byrappa
44030	Tapendra Nath Mitra
44031	Sushil Charan Basack
44032	Gourangachandra Ghosh
44033	Ardhendu Mukhopadhyaya

STUDENTS—(*contd.*)

No.	Name
44034	Hiralal Himatlal Tejani
44035	Dharma Nath Sharma
44036	Anil Kumar Roy
44037	Subhash Chandra Majumdar
44038	Tarun Kanti Ghosh
44039	Kalyan Kumar Pal
44040	Sadananda Mukherji
44041	Barindranath Sarkar
44042	N. V. Krishnamurthy
44043	Kanai Chandra Kowar
44044	Niranjan Kumar Pal
44045	Subal Chandra Das Gupta
44046	Bimalkanti Biswas
44047	Jyotiprasad Basu
44048	Ajoy Kumar Chakrabarty
44049	Barun Kanti Gupta
44050	Rajib Lochan Moulik
44051	Ajit Chandra Banerjee
44052	Basudeb Bagchi
44053	Kanak Kumar Sinha
44054	Amalendu Kundu
44055	Bhabendra Kumar Bera
44056	Gurudas Basu
44057	Subodh Kumar Rakshit
44058	Syamaprasad Gupta
44059	Dhananjay Patra
44060	Gopalapillai Ramachandra Panicker
44061	Gopal Chandra Saha
44062	Prabhatkiran Ghosh
44063	Bimalendu Dasgupta
44064	Nirmalesh Dutta
44065	Subir Kumar Lahiri
44066	Chandra Sekhar Bhattacharyya
44067	Prasantakumar Ghosh
44068	Pabitra Kumar Chanda
44069	Subhas Chandra Banerjee
44070	Lakshmi Kant Tiwari
44071	Manas Kumar Mitra
44072	Nikhil Ranjan Chakraborty
44073	Samir Kumar Dutta
44074	Ashataru Roy Chowdhury
44075	Dilip Kumar Sen
44076	Bholanath Bhattacharyya
44077	Swapan Kumar Sengupta
44078	Sibaprasad Sen
44079	Sailendra Kumar Saha
44080	Dilip Kumar Bandyopadhyay
44081	Samarendra Raychaudhuri
44082	Santi Ram Banerjee
44083	Bharat Bhushan Bagga
44084	Satya Ranjan Basak
44085	Janak Raj Mullick
44086	Ganesh Shankar Tewari
44087	Swapan Kanti Chaudhuri
44088	Sankar Prasad Mukhopadhyay
44089	Ram Gopal Agarwal
44090	Shyamal Bhattacharya
44091	Ramen Chandra Garai
44092	Satish Malhotra
44093	Vinay Kumar
44094	Sat Parkash Gupta
44095	Rabindranath Bandyopadhyay
44096	Srikumar Mukhopadhyay
44097	Subrata Sen
44098	Mrinal Kanti Raychaudhuri
44099	Debasish Basu
44100	Biswajit Das
44101	Debaprasad Karchaudhuri
44102	Sibte Hasan
44103	Susanta Kumar Ghosh
44104	Mangalathu Philip Abraham
44105	Anasuya Prasad Dimri
44106	Nirmal Chandra Mukhopadhyay
44107	Milan Kumar De
44108	Dilip Kumar Mitra
44109	Narayan Dutta Badada
44110	Surendra Kumar Atri
44111	Kunjlal Labhchand Mundhra
44112	Kesab Narayan Chattopadhyay
44113	Puducode Subramania Narayan
44114	Ganga Prasad Gupta
44115	Gadadhar Ghosh
44116	Om Prakash Yadav
44117	Kamal Kumar Bandyopadhyay
44118	Ajit Ranjan Das
44119	Brij Mohan Saran
44120	A. M. Ramaratnam
44121	Subhas Chandra Das
44122	Adhir Kumar Ganguli
44123	Tridib Kumar Chattopadhyay

STUDENTS—(*contd.*)

No.	Name	No.	Name
44124	Arun Kumar Ghosh	44169	Harpal Singh
44125	Himadrinarayan Basu	44170	Kesru Anandram Nangrani
44126	Rabindranath Ghosh	44171	Narayan Ramarao Moktali
44127	Bibhas Chandra Roy	44172	Kadaba Sreenivasamurthy Ramakrishna
44128	Aravinda Sadhu	44173	Shermohamad Musabhai Lalani
44129	Debabrata Sarkar	44174	Amal Kanti Chattopadhyay
44130	Chandidas Banerjee	44175	Burji Furdoonji Mody
44131	Prashanta Kumar Mukherjee	44176	Vasant Nilkanthrao Sagdeo
44132	Surendra Pratap Sinha	44177	Suresh Balkrishna Muley
44133	Amiya Kumar Palit	44178	Om Prakash Kapoor
44134	Suryakant Bhagwandas Golani	44179	Maddipaty Kesava Rao
44135	Brajendra Kisor Bhattacharyya	44180	Satya Prakash Jain
44136	Bijay Krishna Gharui	44181	Sankar Lal Karna
44137	Chittaranjan Basu	44182	Shankerlal Kalidas Patel
44138	Resham Singh Matharoo	44183	Jashwantlal Bhagwandas Mehta
44139	Manabendu Dasmahapatra	44184	Joseph P. George
44140	Dilip Kumar Saha	44185	Motilal Pragji Vegai
44141	Prafullo Nundy	44186	Krishnanchettiar Chudalayandy
44142	Rudra Prosad Nag	44187	Ekanath Rajaram Joshi
44143	Roshan Lal	44188	Mahendrakumar Mahashanker Mankad
44144	Prasanta Kumar Mitra	44189	Raja Ram Saini
44145	Sushil Kumar Majumdar	44190	Gajanan Laxman Deshpande
44146	C. Ramakrishnan	44191	Ajoy Chakravarty
44147	Himadri Sekher Basistha	44192	Babubhai Kanjibhai Barvalia
44148	Anand Prakash Gupta	44193	Koduri Veerabhadra Rao
44149	Susanta Sengupta	44194	Arumugaudayar Jagadeesan
44150	Sanjib Kumar Mukhopadhyay	44195	Venkatraman Radhakrishnan
44151	Nimai Chand Datta	44196	Dasu Upendra Sai Prasad
44152	Arun Kumar Ghosh	44197	Krishnamurthy Gurudathan
44153	Rathin Kanta Nag	44198	Veeraswami Naidu Rajagopal
44154	Komal Singh Jindani	44199	Kumhangad Dayananda Pai
44155	Mohan Tryambak Pathak	44200	M. Pothiraj
44156	Debaprasad Ghosh	44201	Manakkal Kandaswamy Sriraman
44157	Syamalendu Sen Gupta	44202	K. Viswanathan Nair
44158	Ananda Mukhopadhyay	44203	Subramaniam Dhandapani
44159	K. K. Kumaran	44204	Simhadri Balakrishna Rao
44160	Basudeb Ray	44205	Reddi Suryagopala Rao
44161	Nitya Gopal Sarkar	44206	G. Sriramulu Naidu
44162	Samar Chattopadhyay	44207	N. Padmanaban
44163	Rabindra Sen Gupta	44208	G. Bhoopaiah
44164	Becharam Mandal	44209	E. S. Neelakantan
44165	Arun Kumar Bandhopadhyay	44210	S. Subramaniam
44166	Utpalaksha Rakshit	44211	Govindareddigari Reddappa Reddy
44167	Sushil Kumar Roy	44212	R. Venugopal
44168	Narayan Chandra Chakrabarty	44213	Kitamkulathil Cheeramathil Ramachandran

STUDENTS—(*contd.*)

No.	Name
44214	Joginder Singh
44215	Jagdev Singh Kanth
44216	Bhagwat Mandal
44217	Madhukar Shivajirao Mohite
44218	Jawahir Lal Raina
44219	Lukose Philipose
44220	Subhash Chander
44221	Roop Narain Sharma
44222	Mahesh Chander Chopra
44223	Tholath Sunny Verghese
44224	Mulk Raj
44225	Karan Singh
44226	Seetha Jugheegowder Lakshmanan
44227	Ramesh Deepchandra Bellani
44228	S. Harihar Badrinath
44229	Vishwa Nath Mishra
44230	K. N. Nainan
44231	Suresh Kumar Srivastava
44232	Tulsi Ram Gupta
44233	Madan Lal
44234	Inder Raj Sardana
44235	Tek Chand
44236	Ram Mohan Anand
44237	Ram Awtar Malvia
44238	Radhey Mohan Gupta
44239	Ajit Singh Rakhra
44240	Chander Parkash Malik
44241	Banwari Lal Sharma
44242	Jitender Swarup Bansal
44243	Lachhman Kungwani
44244	Anand Thawani
44245	Murli Tejumal Assudani
44246	Jagan Nath Sethi
44247	Makhan Singh
44248	Jas Pal Singh
44249	Amarjit Singh
44250	Bhagwan Dass Goel
44251	Hiro Motiram Hotchandani
44252	Jagwant Lal
44253	Alok Kumar Mitra
44254	Vaidyanath Krishnamurthy
44255	Lab Kumar Basu
44256	Tarit Kumar Basu
44257	Asit Kumar Sinha
44258	Santosh Kumar Roy
44259	Bani Prasad Raychaudhuri
44260	Jagdish Raj Bhatia
44261	Satya Swaroop Rattan
44262	Laxmikant Wahegaonker
44263	P. K. Muraleedharan Pillai
44264	Asishkumar Bhattacharyya
44265	Renukadas Sangwai
44266	Rabindranath Mallik
44267	Tarun Kumar Chatterjee
44268	Purna Chandra Dutta
44269	Girija Prasad Mukhopadhyay
44270	Amal Kumar Palit
44271	Tusharkanti Sen
44272	Umapada Bhowmick
44273	Achintya Mazumdar
44274	Akhilendu Das Gupta
44275	Vasant Ramkrishna Mandale
44276	Gopal Krishna Banerjee
44277	Protip Madhab Bose
44278	Swapan Kumar Ghose
44279	Krishna Dev Chatterjee
44280	Ganpat Namdeorao Chaudhary
44281	Anil Baran Baksi
44282	Sibapada Bhattacharya
44283	Govind Pardikar
44284	Tirunagiri Narasimha Rao
44285	Ratan Kumar Banerjee
44286	Manoranjan Dey
44287	Kamalendu Bandyopadhyay
44288	Jaydeb Pal
44289	Tapas Kumar Basu
44290	Pravesh Chandra Sachindra Nath Thakur
44291	Shrikrishna Kashinath Godse
44292	Bata Krishna Das
44293	Sheo Shankar Singh
44294	Bidhubhusan Bhaumik
44295	Sunil Kumar Chaudhuri
44296	Aswini Kumar Bhattacharya
44297	A. Soundararajan
44298	S. Ramasamy
44299	Pappiah Gajapathy Raj
44300	Samudrala Satyamoorthy
44301	Samarkanti Ghosh
44302	Pranab Guhabiswas
34303	Priya Mohan Bhowmik

STUDENTS—(*contd.*)

No.	Name	No.	Name
44304	Dilip Kumar Mitra	44349	Sarvesh Kumar
44305	Bipra Das	44350	Katpadi Ramachandran Narayanaswamy
44306	Vavilala Venkatasiva Avadhani	44351	Penmatsa Venkatapathi Raju Subbaraju
44307	Deb Ranjan Kundoo	44352	R. Ponniah
44308	Raghunath Das	44353	T. V. Kannan
44309	Arumugam Dhandapani	44354	Rabinder Singh Khurana
44310	Krishnaiyengar Ramaseshadri	44355	Gulab Das Burman
44311	K. V. Venkatasubramanian	44356	Parvathareddi Ramachandra Reddi
44312	Madan Mohan Sarkar	44357	Surinder Singh Chug
44313	Audhesh Kumar	44358	Hemkaran Amarchand Modi
44314	Basanta Kumar Ghose	44359	Ashán Murshed Chand Shah Quadri
44315	Lalgudi Krishnaswami Jayaraman	44360	Onkar Prasad Bhowmick
44316	Mahadeva Arunachalam	44361	Amarjit Singh Virdi
44317	Ramaswami Vasudevan	44362	Udai Pratap Narain Asthana
44318	C. H. Krishnan Namboodiri	44363	Om Parkash
44319	Mohomed Kassim	44364	Suresh Chand Sharma
44320	Ardhendu Sekhar Roy Chowdhury	44365	Khushi Ram Sharma
44321	M. Subramanian	44366	Harjeet Singh
44322	G. Radhakrishnan	44367	Harbans Lal Chawla
44323	Haridas Sinha	44368	Rajendra Prasad
44324	Samiran Kumar Ghosh	44369	Raj Jaswant Singh
44325	B. S. Lakshmana Rao	44370	Mahendra Singh Tyagi
44326	K. Rajamani	44371	Yogeshwar Bhatt
44327	Narayanasamy Ramachandran	44372	Ghanshiam Agarwal
44328	S. Ramanathan	44373	T. Thiruvadisundaram
44329	Gopalakrishnan Seethapathy	44374	Mohan Lal Goyal
44330	Vaithilingam Kanagasabapathy	44375	Kalipada Chattopadhyay
44331	Seerangachetty Varadarajan	44376	Awtar Singh Bahl
44332	Anil Kumar Nandi	44377	Shambhoo Nath Srivastava
44333	Amiya Kumar Chatterjee	44378	Syed Baseerul Hasan Razvi
44334	Ganapathy Gopalakrishnan	44379	Sheo Shanker Pandey
44335	C. Shanmugaperumal	44380	Kshitiranjan Sengupta
44336	Kamalesh Chaudhuri	44381	Harjinder Singh
44337	Amal Kumar Bhattacharyya	44382	Tejpal Singh Sharma
44338	Khagendra Mohan Bose	44383	Vinayak Shripad Joshi
44339	Birendra Nath Roy	44384	Kali Prasad Bose
44340	Debabrata Mitra	44385	Prem Nath Kaila
44341	Asoke Kumar Ghosh	44386	Shailesh Kumar Singh
44342	U. John Bosco	44387	Mahesh Chander Dhamija
44343	Kavaratty Nanjagowder Raju	44388	K. S. Satyanarayana
44344	C. Joghee	44389	Sudarshan Lal Puri
44345	Gopalapillai Radhakrishnan Nair	44390	Krishan Kumar Raheja
44346	Krishan Dass Gupta	44391	Tarkeshwar Sharma
44347	K. Sivarama Manja	44392	Shashikant Vyankatesh Kulkarni
44348	Sistla Hanumath Sastry	44393	Punamchand Bhikachand Jain

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No.	Name
44394	Raj Bahadur Sharma
44395	Hemanta Kumar Bhattacharjee
44396	Sachinandan Bora
44397	Venkataraman Sundaraman
44398	Surjit Singh
44399	Surya Narain Singh
44400	Subir Kumar Sen Gupta
44401	Daljit Singh
44402	Jai Roop Chand Mathur
44403	Om Parkash Sardana
44404	Ghulam Husain
44405	Dahawar Sada
44406	Hardikar Rajaram Bhaskar
44407	Subhas Chandra Pradhan
44408	Kamleshwari Prasad Mehta
44409	Usharanjan Sarkar
44410	Amaresh Sen
44411	Pramod Kumar Hari
44412	Dhairya Prakash
44413	Achyutananda Das
44414	Sudarsan Sahoo
44415	Kadhri Ramanathan
44416	Tadas Rangarao Poorna
44417	Sudarshanachar Srihari
44418	Sahadeb Patra
44419	Chakradhar Patra
44420	Belhur Srikantiah Ramaswamy
44421	Venkatraman Swaminathan
44422	Nirvan Kumar Jain
44423	Naresh Kumar Agarwala
44424	Shio Shankar Sharma
44425	Ramanand Choudhary
44426	Narendra Nath Bhattacharyya
44427	Koshy Mathew Panicker
44428	Benoy Krishna Coomar
44429	Jogendra Prasad Varma
44430	Satyadeo Prasad Thakur Suman
44431	Vettamal Kuriakose Markose
44432	Rajeshwar Prasad Sharma
44433	Sudarshan Kumar Satija
44434	Hari Narayan
44435	Pronab Kumar Mitra
44436	Lalit Chandra
44437	Narinder Kumar
44438	Indar Jit
44439	Romesh Chand Mahajan
44440	Birendranath Mukhopadhyay
44441	Gadadhar Patra
44442	Syamal Baran Roy
44443	Rajpal Motwari
44444	Deep Chand Tewari
44445	Bhagwat Dayal Gupta
44446	Sankarpada Basu
44447	Gada Dhar Hati
44448	Prabhakar Vishnupant Deshpande
44449	Dilip Kumar Das
44450	Madireddi Venkateswara Rao
44451	Meka Subba Rao
44452	Bechu Lal
44453	Bhaskar Singh
44454	Ramesh Chander
44455	Digvijai Singh
44456	Gyan Dutta Singh
44457	Ram Chandra Prasad
44458	Ram Kirpal Singh
44459	Ajit Kumar Dhar
44460	Mahandra Kumar Singnal
44461	Kapildeo Chaudhary
44462	Suresh Narain
44463	Ramesh Chandra Vashishtha
44464	Gopal Lal Pujari
44465	Shyam Sunder Soni
44466	Simanchala Satapathi
44467	Narendra Bhushan Singh
44468	Chandra Shekhar Jha
44469	Mrinal Kanti Chakrabarti
44470	Subhash Chander Khera
44471	Prafulla Kumar Muni
44472	Rajinder Kumar Sharma
44473	Gian Chand Tayal
44474	Yudhistir Mohapatra
44475	M. Raza Khan
44476	Manindra Kumar Das
44477	Satyabrata Sinha
44478	Kuldip Singh Likhari
44479	Dusi Venkata Surya Rao
44480	Mahendra Prasad Sinha
44481	Kamleshwar Prasad Singh
44482	Radhey Raman Prasad
44483	Ram Chandra Sharma

STUDENTS—(*contd.*)

No.	Name	No.	Name
44484	Amrit Lal Chopra	44529	B. V. Venkata Ramu
44485	K. K. Balan	44530	Hari Mohan Arora
44486	Ramwali Singh	44531	Hari Kumar
44487	Sankartosh Biswas	44532	Ram Bilas Singh
44488	Atin Kumar Bhattacharjee	44533	Gopal Saran Saxena
44489	Basanta Kumar Mishra	44534	Tuki Ram
44490	Suryadeo Singh	44535	Bashisth Narayan Singh Mitra
44491	Deo Mun Kumar Pal	44536	Subhash Chandra Gupta
44492	Ram Nath Ram	44537	Damodar Parshad
44493	Krishan Lal Grover	44538	Sohan Lal Sharma
44494	Joseph Chacko	44539	Iqbal Singh Bhatia
44495	Bhim Singh Gupta	44540	Om Prakash Gupta
44496	Sardari Lal	44541	Harish Chandra Pattanayak
44497	Sohan Lal Bhardwaj	44542	Kallapa Krishnapa Borgaonve
44498	Raj Kishore Singh	44543	Kaushlendra Kumar Sinha
44499	K. J. Ramachandran	44544	Madan Lal Dhawan
44500	Onkar Nath Lal	44545	Umacharan Pattanayak
44501	Krishna Chandar	44546	Dwarkaprasad Chunnilal Gupta
44502	Zahoor Mohammad	44547	Mahendera Singh
44503	Jyotish Prasad Jayaswal	44548	Purna Chandra Misra
44504	Avinash Chander Malhotra	44549	Pawan Kumar Jain
44505	N. Muralidharan	44550	Tilak Pall
44506	Bhupendra Nath Handa	44551	Laxmi Raja Ganeswara Sastry
44507	Ganesh Chandra Patra	44552	Kanwar Jit Singh
44508	Temmeti Venkata Ramana Murty	44553	Om Parkash Nayar
44509	Prasanna Kumar Pradhan	44554	Anusuya Prasad Jugran
44510	Janki Jiwan Saran	44555	Mohammad Nazer Ahmed
44511	Shive Kumar Bhargava	44556	Umesh Prasad
44512	Ram Rattan	44558	Hari Shanker Agarwal
44513	R. Muraleedharan Nair	44559	Therambil Sankaran Viswambharan
44514	Manabendra Nath Dutta	44560	Suresh Chander Chawla
44515	Chandidas Bandyopadhyaya	44561	Saghir Ahmed
44516	Shyam Deo Jha	44562	Nawal Kishore Mishra
44517	Balwant Rai Malhotra	44563	Niranjan Rautaray
44518	Daljit Singh	44564	Ramanlal Garg
44519	Narender Nath	44565	Gianchand Harpaldas Rohra
44520	Sashibhusan Panda	44566	Murlidhar Balaji Dongare
44521	Dandapani Subudhi	44567	Rameshkumar Dalal
44522	C. P. Chandrasekar	44568	Mahindra Kumar Makhija
44523	Ashok Kumar	44569	Bilas Basumallik
44524	M. B. S. Vasan	44570	Janardan Prasad Bakshi
44525	Parmeshwari Prasad Sinha	44571	Jagdamba Prasad Dixit
44526	Amar Nath	44572	Tilak Raj Kohli
44527	Barkat Ali	44573	S. M. Nizamuddin Ahmad
44528	Chaman Lal Varma	44574	Nicholas Dedel

STUDENTS—(*contd.*)

No.	Name	No.	Name
44575	Braham Swaroop Harjai	44620	Kanwal Trehan
44576	Abdul Mohmed Sayyed	44621	Sher Singh Khati
44577	Vijay Kumar Rastogi	44622	Chitradurga Seshagirirao Hayavadana Rao
44578	Potnuru Syama Sundar Prusty	44623	Joginder Singh
44579	Ramakrishna Behera	44624	Satish Kumar Kalsy
44580	Dhanurdhar Mishra	44625	Rajnesh Chander Bhatia
44581	Bhuwaneshwar Singh	44626	Pavankumar Matiomal Madnani
44582	Khitindra Kumar Mohanty	44627	Mahendra Prasad Srivastava
44583	Banodhar Misra	44628	Sohan Lal Verma
44584	Ramesh Kumar Paul	44629	Ram Charitra Sahu
44585	Krishan Kumar Kakria	44630	Majji Rama Satyanarayana
44586	Rameshiah Singh	44631	Ajaya Kumar Dikshit
44587	Shreeram Madhaorao Mulay	44632	Bishan Singh Chakrayet
44588	Siya Nand Saini	44633	Sivabrata Sen
44589	Sahadeb Chandra Paul	44634	Ved Prakash Bansal
44590	Jagmandar Dass Jain	44635	Satish Chandra
44591	Bhim Narain Saha	44636	Rabindranath Naik
44592	Bhim Sain Behl	44637	Prem Vardhan
44593	Shyamal Kumar Sinha	44638	Gaganabehari Mohanty
44594	Krishan Dev Kochhar	44639	Kirpal Singh Kambo
44595	Bibhuti Bhushan Tiwari	44640	Tek Chand Kalonia
44596	Mohammad Muslim Khan	44641	Sharvan Kumar Sahni
44597	Ram Bahadur Sinha	44642	Vasant Dattatray Pujari
44598	Vijaya Balawantrao Ghatikar	44643	Ramchandra Prasad
44599	Raman Behari Lall	44644	Shatrughan Prasad Singh
44600	Bhagawan Das	44645	Hari Narain
44601	Govind Palai	44646	Prafulla Kumar Das
44602	Girish Prasad Mathur	44647	Pandava Prasad Deo
44603	Jogendra Singh Alhuwalia	44648	Bishnu Charana Sahu
44604	Kamal Kumar Das	44649	Madan Lal Chawla
44605	Amritpal Singh	44650	Shri Kant Trivedi
44606	Harjeet Singh	44651	Keshab Sahu
44607	Prakash Chandra Srivastava	44652	Satish Chandra Lal
44608	Ramesh Gyanba Undale	44653	S. Dalip Singh
44609	Ishwar Dayal Gupta	44654	Ram Bhaj Garg
44610	Naranjan Singh	44655	Shri Pal Jain
44611	Iswar Chandra Sahoo	44656	Tapas Kumar Ray
44612	Vajjha Venkatramaiah	44657	Chuni Lal
44613	M. Seraj Alam	44658	Bidhan Roychoudhuri
44614	Pattam Nagarajan Balasubramanian	44659	Alakh Narayan Mehta
44615	Tukaram Dada Shinde	44660	Nand Kishore Singh
44616	Ramjee Singh	44661	Pratap Singh
44617	Nand Kishore	44662	Ranjit Kumar Nandy
44618	Akhileshwar Pati Tripathi	44663	Chandrika Prasad Viswakarma
44619	Subhas Chandra Singhal	44664	Rajan Sreenivasan

STUDENTS—(*contd.*)

No.	Name	No.	Name
44665	Tapan Kumar Ganguly	44710	Puthenpurayil Varghese Koshy
44666	Qazi Mohammad Ateeque	44711	Manik Chandra
44667	Brij Ballabh Sharma	44712	Kashinath Anandrao Deshmukh
44668	Kalavagunta Prabhakar	44713	Virendra Kumar Rai
44669	Krishnaji Balwant Sidhaye	44714	Prem Singh Chabra
44670	Sabirhusain Gulamhusain Shaikh	44715	Prabha Shankar Gupta
44671	Mahendra Jeet Singh Ahluwalia	44716	Dharm Vir Wadhwa
44672	Girija Nandan Sharma	44717	Namburi Durga Prasad Rao
44673	Krishna Kumar Gupta	44718	Gajanan Fakirappa Dhabadhabe
44674	Rajendrakumar Kishanlal Gupta	44719	Manohar Lal
44675	Banshi Dhar Gairola	44720	Krishna Narayan Ghadge
44676	Thakur Chittaranjan Prasad Singh	44721	Harmit Singh Sandhu
44677	Hari Om Prakash Saxena	44722	Vannakambodi Srinivasan Ranganathan
44678	Gosala Lakshminarayana Bhaskara Rao	44723	Nanbelal Jain
44679	Vimal Kumar Jain	44724	Ramgopal Asati
44680	Roopachand Ranga Khot	44725	N. Balasubramanian
44681	Jivan Vasant Utgikar	44726	Subramanian Raman
44682	Sham Lal	44727	V. Paulose
44683	Girish Chander Shukla	44728	Kewal Singh Thind
44684	Alok Ranjan Bhaumik	44729	Rajendrababu Ambalal Shah
44685	Subba Rao Narasimha Murthy	44730	Asha Ram Chowdhury
44686	Yadla Prakasa Rao	44731	Upinder Singh
44687	Sharad Govind Dhande	44732	Manohar Singh
44688	Mohamad Husen Babalal Shaikh	44733	Ghan Shyam Lal Mathur
44689	Nanoo Natarajan	44734	Yadu Nandan
44690	M. E. Isaac	44735	Mohan Rawtani
44691	Ram Prasad Goyal	44736	V. Jaishankar
44692	Suresh Gopalrao Dixit	44737	Rabindranath Panda
44693	Jogindar Pal Khanna	44738	Bimala Prasad Patnayak
44694	Kachrulal Shaligramji Tapadiya	44739	Pramod Kumar Chadha
44695	Akella Sree Rama Murty	44740	Rashmikant Ramanlal Dalal
44696	Brijendra Kumar Sharma	44741	Krishna Bahadur Singh
44697	Narayan Prasad Gupta	44742	Som Parkash
44698	Arvind Ramchandrarao Shivane	44743	R . Subramaniam
44699	Prithvi Raj Dawara	44744	Ram Bharosay Gupta
44700	Sampati Kumar Dubey	44745	Bimal Chandra Chakraberty
44701	Prem Singh Aujla	44746	Badan Chandra Phukan
44702	Sidheshwar Prasad Misra	44747	Gian Chand Gadi
44703	Yog Raj Chowdhary	44748	Sunkara Sitaramanjaneyulu
44704	Kailash Chandra Goyal	44749	Devki Nandan Goel
44705	Bheemaraju Sankara Narayana Raju	44750	Om Prakash Sharma
44706	Ramaswami Rajam	44751	Awatar Singh Dhiman
44707	Vijay Trimbak Abhyankar	44752	Sukesh Ranjan Choudhury
44708	A. Yagnaswamy Ramachandran	44753	Pijush Kanti Deb
44709	Bhagwan Tilokchand Rajani	44754	Devendraprasad Bhagvatprasad Dave

STUDENTS—(*contd.*)

No.	Name
44755	Kanan Behari Krori
44756	Halsangadi Kesahv
44757	Dwarka Nath Sahni
44758	Mohammad Haneef
44759	Jiban Kumar Gangopadhyay
44760	Mahabir Ram
44761	Jagdish Chandra Saha
44762	Kuttan Rajagopalan
44763	Amar Nath Raina
44764	S . V. Ashok Kumar
44765	Shridhar Bandopanta Mangalvedhe
44766	Haresh Chandra Dubey
44767	Ashokkumar Yeshwant Nashikkar
44768	Udai Bhan Singh
44769	Pabitra Bhushan Saha
44770	Manotosh Biswas
44771	C . K. Narayanan
44772	Jagannath Prasad
44773	S . N. Narasappa
44774	Mehar Singh
44775	Dev Brat Bhalla
44776	Chander Parkash
44777	Ram Lakhan Ojha
44778	Abdul Rauf Ansari
44779	Siya Ram Trivedi
44780	Santi Ranjan Sen
44781	Sant Ram
44782	Subhash Kumar
44783	Satya Vir Srivastava
44784	Mohammad Ishaq Khan
44785	Jasbir Singh
44786	Navin Chandra
44787	Ram Charan
44788	Har Saran Saxena
44789	Indra Prasad
44790	Radha Krishna
44791	Rajinder Kumar
44792	Jagdish Mishra
44793	Subramanya Iyer Balakrishna
44794	Vidya Sagar
44795	Laxmi Narayan Agrawal
44796	Vijay Pal Verma
44797	Autar Kishen Raina
44798	Hari Mohan Sinha
44799	Kanhaiya Lal
44800	Sushil Kumar Bansal
44801	Parmeshwari Prasad
44802	Surendra Narain Gaur
44803	Shiva Narain Singh
44804	Pushpinder Singh Grover
44805	Sheo Nath Prasad
44806	Inder Mohan Chopra
44807	Shankar Parumal Aswani
44808	Krishna Chandra Srivastava
44809	Kalyan Dass
44810	Nakul Dev
44811	Dharam Veer Singh
44812	Gajraj Singh Tyagi
44813	Umesh Chandra Pande
44814	Ravindra Nath Mehrotra
44815	Kripa Shanker Sharma
44816	Manoharlal
44817	Yogendra Singh
44818	Mukand Lal Mohan
44819	Premchand Srivastava
44820	Keshava Das Mehrotra
44821	Triveni Prashad Sharma
44822	Ishwar Kumar Sharma
44823	Hasmukh Tejmal Agrawal
44824	Krishan Kanhaiya
44825	Ranbir Sahai Behl
44826	Darshan Ram
44827	Krishan Lal Goel
44828	Om Prakash Srivastava
44829	Rajkumar Singh
44830	Lachhi Ram
44831	Mahabir Prasad Goel
44832	Shiv Raj Chandra Agrawal
44833	Chander Mohan Malhotra
44834	Siri Chand
44835	Manohar Lal Verma
44836	Surendra Mohan
44837	Donald Albert Blewitt
44838	Gopal Prakash Jauhari
44839	Pritpaul Singh Soodhi
44840	Shiva Piarey Srivastava
44841	Jasbir Singh
44842	Chekka Kesava Rao
44843	Naranjan Lal Shahi
44844	Kuldip Singh

STUDENTS—(*contd.*)

No.	Name	No.	Name
44845	Vijay Kumar Sachdev	44891	Shri Krishan Gupta
44846	Sheo Kumar	44892	Ram Pal Singh
44847	Atteli Janardhan	44893	Krishnanand Pandey
44848	Hem Chandra Agarwala	44894	Laxman Singh
44849	Kailash Chandra Gupta	44895	Minde Rajee Vittal Rao
44850	Brijendra Kumar	44896	Subhash Chandar Dua
44851	Nityananda Sahoo	44897	Anupindi Subramanyam
44852	Ram Shankar Misra	44898	Sarju Prasad
44854	Trilokh Nath Moza	44899	Dooda Venkata Narayana
44855	Surendra Kumar Jain	44900	Badri Prasad Sharma
44856	Dinesh Bhushan	44901	Jagat Ram Arora
44857	Keshav Prasad Srivastav	44902	Marabathina Narayana
44858	Nawal Kishore	44903	Ranajit Kumar Pal
44859	Amrit Lal Malhotra	44904	Raghuwar Dayal
44860	Jai Bhagwan Goel	44905	Ved Parkash Arora
44861	Bishan Swarup Srivastava	44906	Balwant Singh Thakur
44862	Dwarika Nath Jaitley	44907	Gopala Ganesan
44863	Swarnendu Chaudhuri	44908	Narendar Kumar
44864	Kashi Ram	44909	Harnek Singh Mann
44865	Suresh Chandra Lakhani	44910	Mohan Sadashiv Sapre
44866	Gobind C. Ahuja	44911	Bhim Deo Singh
44867	Jai Prakash Garyali	44912	Nar Singh Dass
44868	Ramji Lal Sharma	44913	Prafullakumar Kantilal Parikh
44869	Yoginder Kumar	44914	Shyam Narayan Shukla
44870	Sudhaker Dube	44915	Goroor Srinivasan Parthasarathy
44871	Autar Singh	44916	Baldev Krishan Single
44872	Abdus Salam Mallick	44917	Thirucheri Varadarajan Sampathkumar
44873	Sudesh Kumar Mohan	44918	Joginder Mohan Chadha
44874	Giri Kumar Gaddam	44919	Vittal Rao
44875	Eday Ramakoteswararao	44920	Surendra Kumar Shrivastava
44876	Ram Reddy	44921	Dharam Pal
44877	Kopparti Balarama Murty	44922	Bhaurao Vyankatesh Kasulkar
44878	Manohar Singh	44923	Om Prakash Katare
44879	Janak Raj	44924	Dasharathlal Jibhaiji Brahmbhatt
44880	Subhash Chander	44925	Vijaykant Pandurang Balwatkar
44881	Kolluri Subbarao	44926	Manohar Balkrishna Acharya
44882	Nittala Venkata Ramana Murthy	44927	Jagdish Singh
44883	Mohammad Rafique	44928	Som Nath Chitkara
44884	Tankala Panduranga Murthy	44929	Surendra Kumar Jain
44885	Vinod Kumar Gupta	44930	Jeetmal Jain
44886	Dibakar Acharya	44931	Arvind Shankar Daptardar
44887	Gopi Chand	44932	Mahendra Kumar Oza
44888	Jashwant Singh Yadav	44933	Harnek Singh
44889	Ram Sharan Das Agrawal	44934	Dwijendra Nath Datta
44890	Jagdish Kumar	44935	Lala Rajendra Nath

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No.	Name
44936	Pasupumoori Satyanarayana
44937	Avancha Venkata Ramana Pantulu
44938	Gulab Chandra Gupta
44939	Raj Kumar
44940	Kulwant Singh Randhawa
44941	Usmankhan Rustumkhan Pathan
44942	Kailash Nath Bhatia
44943	Ranbi Singh Minhas
44944	Arun Kumar Ganguly
44945	A. Madhav Rao
44946	Narmada Prasad Vishwakarma
44947	Jayant Madhav Gokhale
44948	Avtar Singh Jassal
44949	Kelankutty Chellan
44950	Ishwer Chand Manchanda
44951	Krishnagopal Kumari
44952	Pranabananda Ray
44953	Yash Pat Duggal
44954	Shrikant Gajanan Pitre
44955	Dhirubhai Bavabhai Patel
44956	Hira Nand Gakhar
44957	Prem Kumar Ghai
44958	Gian Singh
44959	Ramesh Chand Gupta
44960	Kishori Lal Khurana
44961	Har Bhajan Singh
44962	Shahaji Ramchandra Jagadale
44963	Vas Dev Shori
44964	Gangadharrao Dinker Borwankar
44965	Shangara Singh
44966	Sudershan Lal Bhatia
44967	Raghavendra Tirumalrao Sirsi
44968	Kuldip Singh Gill
44969	Kashmiri Lal Munjal
44970	Kundan Singh
44971	Gurcharan Singh
44972	Vijay Kumar Bhasin
44973	Mohan Lal Gupta
44974	Rashpal Singh
44975	Shamsher Singh Gulati
44976	Raghbir Singh
44977	Raghunath Parshad
44978	Satya Parkash Goel
44979	Kuldip Singh
44980	Des Raj
44981	Surendar Nath Dwivedi
44982	Jiwan Lal Dalla
44983	Jogindar Singh
44984	Om Parkash Joshi
44985	Harvinder Singh
44986	Inderjit
44987	Tarlochan Singh
44988	Om Parkash Bhatia
44989	Anand Kumar
44990	Dawarka Dass Gumber
44991	Devender Kumar Duggal
44992	Ishwar Chand
44993	Kewal Krishan Chhabra
44994	Wazir Chand
44995	Ajit Singh
44996	Manohar Lal Layal
44997	Manjit Singh
44998	Rajendra Kumar Sharma
44999	Karnail Singh Rakhra
45000	Ram Kumar Sharma
45001	Satya Nand
45002	Kewal Krishan Singla
45003	Dalip Singh
45004	Harbans Lal
45005	Sudarshan Lal Gandhi
45006	Gurbachan Lal
45007	Ved Parkash
45008	Rattan Lal
45009	Bhim Sen Juneja
45010	Dharm Parkash Bansal
45011	Roshan Lal Sharma
45012	Amrik Singh
45013	Beant Singh Ghumman
45014	Gajinder Pal Singh
45015	Dharam Pal Taneja
45016	Om Parkash
45017	Tek Chand
45018	Pratap Chandra Chaturvedi
45019	Avinashi Lal Dawara
45020	Shriyansh Kumar Jain
45021	Hejmadi Muralidhar Rao
45022	Subhash Vinayak Paranjape
45023	Goverdhan Lal-Bajaj
45024	Sorab Rustomji Sopariwala
45025	Jasbir Singh Anjla

STUDENTS—(*contd.*)

No.	Name
45026	Gur Bachan Singh
45027	Dhoop Chand Sogani
45028	Narayanaswami Nagarajan
45029	G. Ramachandran Nair
45030	Arvind Devidas Deodas
45031	Ravinder Kumar
45032	Surendra Kumar Puri
45033	Sheonarayan Patil
45034	Shaikh Nurul Anwar
45035	Buttu Radha Kishan
45036	R. Vasu
45037	Jai Singh
45038	Vijendra Kumar Goel
45039	Bangalore Krishnarao Vidyaranya
45040	Jayantilal Ambalal Jambali
45041	Ishwar N. Chainani
45042	Biman Bihari Mitra
45043	Sunamay Mukhopadhyay
45044	Ram Lal Makol
45045	Mahendra Shivlal Patel
45046	Abdul Hamid
45047	Nityanand Singh Jaipuri
45048	Ashoke Kumar Chatterjee
45049	Sudhakar Chintaman Soman
45050	Pundlik Maruti Deshmukh
45051	Narayan Shankar Sahai
45052	Bhabaniprasad Chakraborty
45053	Kavil Puthanveetil Chandrasekharan Nair
45054	Sudhi Kumar Mondal
45055	Bhubneshwari Prasad Bhagat
45056	Jagdamba Prasad Srivastava
45057	Sukumar Sarkar
45058	Chada Sreenivas Reddy
45059	Amar Chand Jain
45060	Shri Dhar Sharma
45061	Ramesh Chandra Dixit
45062	Karan Singh Hooda
45063	Gurdev Singh
45064	Harnek Singh
45065	Yudhishtar Kumar Thakur
45066	Subhash Chander Mahant
45067	Anil Venctesh Desai
45068	Jaspal Singh Kainth
45069	Devasikhamani James Prabhakara
45070	Ramesh Lachhmandas Bhatia
45071	Ramesh Chand Jain
45072	Amalananda Ghosh
45073	Pawan Kumar Aggarwal
45074	Prem Narayan Tiwari
45075	Prafulla Parsottam Patel
45076	Parmodh Kumar Sapra
45077	Om Parkash
45078	Alak Kumar Sengupta
45079	Mohan Lal Maniram Raichandani
45080	Parbati Nath Dhar
45081	Satyasankar Biswas
45082	Sankar Kumar Pal
45083	Birja Nand Singh
45084	Ramesh Madhao Joshi
45085	Nasib Chand Bansil
45086	Nakul Chandra Nandy
45087	Manicka Shanmugham
45088	Tusar Kanti Mukhopadhyay
45089	Jayant Kumar Mukherjee
45090	Prahlad Ram
45091	Talukedar Singh
45092	K. Mahboob Khan
45093	Suresh Kumar
45094	Jugendra Kumar Arora
45095	Balraj Krishan Bhagat
45096	Babu Singh
45097	Krishna Kumar
45098	Mohammed Rafat Ali
45099	Gyan Saran Mathur
45100	Shyam Kishore Sharma
45101	Sham Murari Lal
45102	Amar Singh Soni
45103	Gantisurya Subramanyam
45104	Maroli Kanoth Balagopalan
45105	Dinshaw Navalshaw Billimoria
45106	Harendra Lal Karmakar
45107	Panna Lal Simlote
45108	Gian Sagar Batra
45109	Karam Singh Matharu
45110	Narender Kumar Mehta
45111	Balbir Singh
45112	Shashikant Digamber Phutane
45113	Narendra Kumar Srivastava
45114	Shyam Narain Prasad Sinha
45115	Vishwanath Mallayya Shriram

STUDENTS—(*contd.*)

No.	Name	No.	Name
45116	Ramakant Anantlal Bhagat	45161	Vijay Kumar Mathur
45117	Navinchand Popatlal Kothadiya	45162	Rajeshwar Nath
45118	Keshranjan Prasad Sinha	45163	Bimal Mukherjee
45119	Madan Mohan Pagal	45164	Ram Pal Singh Panwar
45120	Chandra Pal Singh	45165	Khalil Ahmad Khan
45121	Tej Bahadur	45166	Suresh Chand Jain
45122	Ramesh Kumar Kapoor	45167	Sankaran Veetil Gopalakrishnan Nair
45123	Ustabananda Sahoo	45168	Hakumat Rai Gupta
45124	Davindar Singh	45169	Pooran Singh
45125	Ramesh Ganesh Page	45170	Raghu Nath Rajan
45126	Lalu Babu Attar	45171	Tejindar Singh Dureja
45127	Arunkumar Dandekar	45172	T. L. Madhavan
45128	Kunnavalkkam Elyavalli Pattabiraman	45173	Dinesh Kumar Aggarwal
45129	Ashok Kumar Chatterji	45174	Subhash Chander
45130	Mansukhlal Pitamber Dabhi	45175	Thakur Bachchan Prasad
45131	Sunder Dass Khurana	45176	P. K. Joseph
45132	N. V. Satya Bhaskararamasarma	45177	Charanji Lal Gupta
45133	Nilmoni Mitra	45178	Kashmiri Lal
45134	Purnendusekhar Das	45179	Lingam Srinivasan
45135	Sant Kumar Chopra	45180	Sailaja Pada Chakravarti
45136	Vijai Kumar Varma	45181	Maganlal Manjibhai Patel
45137	Jagdish Prasad Kukreti	45182	Mukundbhai Madhavlal Joshi
45138	Virendra Kumar Sawhney	45183	T. S. Raveendranathan
45139	Bhagavathula Ramakoteshwar Rao	45184	Ram Krishna Prasad Sinha
45140	Vishnu Raghunath Kulkarni	45185	Ramesh Datta Sharma
45141	Nityanand Joshi	45186	Sudarshan Somnath Naik
45142	Trannath Bandyopadhyay	45187	Tummala Satchitananda Reddy
45143	Dayananda Govardhan Kamath	45188	Arvind Vaman Apte
45144	Avicote Thomas Varghese	45189	Karisoolndamangalam Sankaran Vaikuntam
45145	Shyama Nand Jha	45190	Madhukar Bhivrao Panse
45146	Krishna Pratap Singh	45191	Pritam Singh Tul
45147	Subir Kumar Sarkar	45192	Mahaveer Singh Sarwar
45148	Sushil Chandra Mathur	45193	Anil Kumar Chatterjee
45149	Kunwar Ram Vir Singh	45194	Bint Kumar Dhar
45150	Vas Dev Khurana	45195	Vikramaditya Jha
45151	Sunil Kumar Misra	45196	Shiam Krishna Kapoor
45152	Mahendra Kumar Tuli	45197	Srinivasa Krishna Kishore
45153	Somalinga Sankaranarayana Visweswaran	45198	Chiravuri Ramakrishna
45154	Virendra Mohan Gupta	45199	Mylswamy Gownder Kuppuswamy
45155	Chuni Lal Bazaj	45200	Surendra Mohan Kapur
45156	Hussain Basheer	45201	Surinder Kumar Bhatia
45157	Vijay Shanker Saxena	45202	Harbhajan Singh
45158	Bhushan Kumar Mehta	45203	Shrikant Dattatraya Sadekar
45159	Someswara Venkata Ramamurthi	45204	Rajaram Kashinath Kolwalkar
45160	Krishna Govind Sharma	45205	Kumud Kumar Khare

STUDENTS—(*contd.*)

No.	Name
45206	Satish Kumar Gupta
45207	Vinod Kumar Sethi
45208	Amar Singh
45209	Karwan Surendher Kumar
45210	Amrik Singh Bhugra
45211	Bhanu Pratap Tiwari
45212	Tushar Kanti Bhattacharyya
45213	Lachhman Das
45214	Narayana Suresh Babu
45215	Umakant Ichhalal Shethna
45216	Vimal Kishor Kulshrestha
45217	Kannanoor Puthanmadathe Sreekumaran Unni
45218	Paras Nath Ram
45219	N. Sadananda Hegde
45220	Rajendra Rai
45221	Krishna Gopal Gupta
45222	Radha Raman Chadha
45223	Lal Chand Jain
45224	Samir Das Purkayastha
45225	Kandepu Gayathri Prasad
45226	Har Bhagwan Dass Verma
45227	Pitabas Khatua
45228	Amrit Lal Saini
45229	Mohan Thawardas Sahajwalla
45230	P. Ramanatha Pai
45231	Nekkanti Prabhakara Rao
45232	Bimal Chandra De
45233	Jiban Chandra Chakrabarti
45234	Madan Mohan Bandyopadhyay
45235	Dipak Lahiri
45236	Basudeb Rakshit
45237	Harish Chander Sambhi
45238	Nirmal Singh Ahluwalia
45239	Kasturi Lal
45240	Girish Chander
45241	Kunja Bihari Mohanta
45242	Sibaram Chattopadhyay
45243	Venkateswaran Mahadevan
45244	Brij Raj Saran Srivastava
45245	Thekkemannangath Chandrasekharan
45246	Indrajeet Pandey
45247	Ramachandraiyer Madhavan
45248	Anant Raghunath Dixit
45249	Sewa Singh
45250	Bhatlapenumarthy Venkata Ramana Rao
45251	Randhir Singh
45252	Ratan Singh
45253	Surindra Nath
45254	Vidya Prakash
45255	Vrudhichandra Shamji Shah
45256	A. Raman Menon
45257	Samir Kumar Datta
45258	Santisankar Das
45259	Amiya Sankar Majumdar
45260	Biswanath Halder
45261	Sukumar Das
45262	Baridbaran Kar
45263	Manoj Kumar Sanyal
45264	Susit Kumar Pal
45265	Syamalkumar Basu
45266	Mrinal Kanti Mazumder
45267	Vinod Kumar Goel
45268	Mahesh Prasad Sharma
45269	Dilipkumr Chimubhai Kharidia
45270	Anand Mohan Chaturvedi
45271	Har Charan Singh Dedi
45272	Shiva Kumar Verma
45273	Akhouri Ram Narayan Prasad Sinha
45274	Dilip Kumar Mukhopadhyay
45275	Ranendra Nath Gupta
45276	Nitai Chand Basak
45277	Asok Kumar Niyogi
45278	N. Vaidyanatha Sarma
45279	Koralla Venkata Visweswara Linga Rao
45280	Perimaruthar Jankiram Ramamurthy
45281	Kolaparthi Manikyala Rao
45282	Lingareddy Sambhuprasada Reddy
45283	Gopalachary Soundararajan
45284	Kamadana Gopalakrishna Rao
45285	Borra Subramanya Reddy
45286	Subir Kumar Sen
45287	Subikas Chattopadhyay
45288	Satish Chandra Bisaria
45289	Prasanna Kumar Satapathy
45290	Chandra Sain
45291	Virendra Pal Singh
45292	T. S. Viswanathan
45293	Trilochan Sahu
45294	K. S. Subrahmaniam Nambudiripad

STUDENTS—(*contd.*)

No.	Name
45295	Bikkar Singh Chhina
45296	Murlidhar Trimbak Mardikar
45297	K. Ramachandra Pai
45298	Pannala Sree Ramachandra Murthy
45299	Shankar Singh Shekhawat
45300	Dev Raj Goel
45301	Swarn Singh
45302	Kaliappan Thangamani
45303	Kulbhushanlal Amritlal Sethi
45304	Grish Chandra Pandey
45305	Nirmal Kumar Bhattacharjee
45306	Jagdish Chander Goyal
45307	Panchanon Bandyopadhyay
45308	Jagat Kumar Kalia
45309	Ravinder Kumar Lamba
45310	Surjit Singh Jally
45311	Indarjit Singh
45312	Partap Chand Saini
45313	Phool Deo Prasad Srivastava
45314	P. Narainswamy Sainath Iyer
45315	Jyoti Ranjan Mitra
45316	Dharam Pal Singh Verma
45317	Vasant Mrigendra Mestri
45318	Krishnamurthyaiyar Vaidyanathan
45319	Mohan Lal Rajput
45320	Jai Ram Sharma
45321	Bal Krishan Malhotra
45322	Gabbita Gurunadham
45323	Karamjit Singh Puar
45324	Yash Pal Singh
45325	Suraj Parkash Parnami
45326	Vaman Shankarrao Deshpande
45327	Hirji Khetshi Shah
45328	Kalyan Singh Patel
45329	Sadashiv Balkrishna Navangule
45330	Subbanarasu Arunachalam
45331	Bidhubhushan Saha
45332	Deb Kumar Mitra
45333	Sukumar Datta
45334	Dilip Kumar Gangopadhyay
45335	Panchanon Bose
45336	Chiranjeeb Sen Gupta
45337	Mukulkumar Bhattacharya
45338	Kanwar Sher Singh Jain
45339	Shrikant Krishna Modak
45340	Sivaji Sen
45341	Nilkanth Kisan Patil
45342	Kanak Narayan Basu
45343	Arun Sankar Chatterjee
45344	Kutyar Srinivas Rao
45346	Diptendu Jyoti Sinha
45347	Inderjit Singh
45348	Shambhu Prasad Verma
45349	Harihar Singh
45350	Debesh Ranjan Dutta
45351	Suresh Kumar Bansal
45352	Bal Krishan
45353	Yeshwant Keshav Kulkarni
45354	Teg Singh
45355	Priti Pal Singh
45356	Devindar Malik
45357	Sunil Kumar Chatterjee
45358	Brijendra Kumar Agrawal
45359	Radha Charan Agarwal
45360	Gurdev Singh Sirra
45361	Jagat Bandhu Dei
45362	Priyatosh Kar
45363	Arun Kanti Ghosh
45364	Nani Gopal Aich
45365	H. S. Prahalad
45366	Devidas Anant Shetti Dalal
45367	Gurdev Singh Passi
45368	Shakil Ahmad
45369	Krishnaswamy Rajagopal
45370	Rabindra Sankar Das
45371	Shrikrishna Vithal Hawaldar
45372	Gurumoorthyiyer Srinivasan
45373	Sadhan Kumar Bandyopadhyay
45374	Hemchandra Thakordas Petigara
45375	Venkatarama Gopalan
45376	Krishnarao Raghavendra Rao
45377	Nand Lal
45378	Menothuparambil Paran Bhaskaran
45379	Krishna Chandra Pant
45380	Diwakar Wasudeo Vaidya
45381	Dilip Kumar Nandy
45382	Kothandaraman Loganathan Iyer
45383	Subhash Chander
45384	Mela Ram Ghai
45385	Ravi Prakash

STUDENTS—(*contd.*)

No.	Name
45386	Harish Chander
45387	Amal Kanti Ghosh
45388	Darshan Lal
45389	Sham Abasaheb Vaze
45390	Prahlad Singh Mangla
45391	Kedar Lal L. Mathur
45392	Laxmi Kant Sharma
45393	Anil Kumar Roy
45394	Kasarameni Veerendranath
45395	Krishna Appanna Devagiri
45396	Dibakar Das
45397	Popatlal Kanji Chavda
45398	Krishnamoorthy Kailasam
45399	Rengaraja Lakshmipathy
45400	Chandi Das Nath
45401	Nabagopal Karmakar
45402	Sunilkumar Mandal
45403	Prasanta Kumar De
45404	Asok Kumar Gangopadhyay
45405	Syamal Basu
45406	Dilip Kumar Das Chaudhuri
45407	Rabindra Nath Raha
45408	Shyamalendu Dutta
45409	Pulak Kumar Ray
45410	Biresh Prasad Chaudhuri
45411	Animesh Kumar Mojumdar
45412	Dilbag Rai Kohli
45413	Nirendra Kumar Singha Choudhury
45414	Baidyanath Chaudhuri
45415	Nallur Ramachandraiyer Kannan
45416	Rameshchandra Sharma
45417	Shyam Vir Singh
45418	Hari Pada Das
45419	Brajesh Narain Singh
45420	Sreedhar Chatterjee
45421	M. S. Dinamani
45422	Syed Abdul Jameel
45423	Sojan Rustomji Vazifdar
45424	Paresh Nath Ghosh
45425	Gouranga Chandra Mandal
45426	Kuppuswamy Venkata Ramani
45427	Awat Sadhuram Lokwani
45428	Narpat Singh Mehta
45429	Manohar Lal Gupta
45430	Krishna Nand Shrinig
45431	Krishna Kant Joshi
45432	Kanthappa Murugiah
45433	Chander Parkash Taneja
45434	Krishna Pada Majumder
45435	Kali Sankar Sen
45436	Hira Lal Fotedar
45437	Shrimati Ramalakshmi Amma Kamalamma
45438	Chandra Mauleshwar Jaruhar
45439	M. Sundaramoorthy
45440	Rangaswamy Parthiban
45441	Maturi Leela Mohan Rao
45442	Prasanna Kumar Pati
45443	Prem Prakash Verma
45444	Sanjib Kumar Ghosh
45445	Prabhakar Gangadhar Mandhare
45446	Prabhakar Trimbak Satbhai
45447	Rich Pal Singh
45448	Gopal Keshavrao Paithane
45449	Valaja Krishnaswamy Perumal
45450	Mohinder Singh Bhullar
45451	Kausikkumar Basu
45452	Krishnamoorthy Kunjithapatham
45453	Ramesh Chander Bagga
45454	Vilayati Ram Chhokra
45455	Sanjoy Kumar Chanda
45456	Madan Chintaman Tendulkar
45457	Joseph Thomas
45458	Mohan Lall
45459	S. Janakiraman
45460	Khan Chand Girdhar
45461	Dwijendra Chandra Das
45462	Amarendranath Ghosh
45463	Manotosh Pal
45464	Ajit Kumar Ghose
45465	Dharam Pall Ghai
45466	Haresh Chandra Sharma
45467	Om Prakash
45468	Abani Kumar Ray
45469	Lalta Parshad Garg
45470	Ram Prakash
45471	Chander Mohan
45472	Suresh Dattatyagi
45473	Mohammed Abdur Rahman
45474	Sankara Loganatham
44575	Munish Chander Sethi

STUDENTS—*(contd.)*

No.	Name	No.	Name
45476	Dwijendra Singh Sarin	45486	Bhagwant Singh Dhillon
45477	Gian Chand Sethi	45487	Paresh Nath De
45478	Amrit Rai Parhawk	45488	Chhabinath Sahai
45479	Hossur Bhaskariah Ramakrishnaiah	45489	Rabindera Nath Mehta
45480	Vinod Kumar Dube	45490	Sohan Lal Malhotra
45481	Arunesh Kumar Agrawal	45491	Mahesh Mal Bhandari
45482	Vasant Hanamantrao Gourav	45492	Shiva Ram Singh
45483	Nand Gopal Bhardwaj	45493	Krishna Kant Lal Srivastava
45484	Subhash Chandra Sharma	45494	Ima Surendra Shetty
45485	Bibhutibhushan Saha	45495	Gian Chand Sofat

EMPLOYMENT SERVICE

This service is intended for the benefit of members of the Institution and for the Government, industrial and other organizations employing engineers. It is hoped that the employers will make full use of this service to obtain their requirement.

A small charge of Rs. 5 per insertion will be made to members for notices appearing in the 'Situations Wanted' column.

In the 'Situations Vacant' column a charge of Rs. 2 per line will be made.

Replies to advertisements should be addressed to Employment Service, The Institution of Engineers (India), P. O. Box No. 669, Calcutta 20, except where otherwise stated.

SITUATIONS VACANT

Mittal Brothers, 94 Okhla Industrial Estate, New Delhi 20, require for their Production Department, manufacturing electrical appliances and hardware goods, an electrical engineer with practical mechanical experience.

SITUATIONS WANTED

YOUNG ENGINEER, age 31 years, Student of the Institution of Engineers (India), possessing Electrical Supervisors' License and Diploma in Electrical Engineering securing 62% marks, having 4 years experience in teaching, supervision and maintenance, and 2 years in electrical wiring, installations, repairs, etc., and can speak fluently Hindi, English and Gujarati, seeks any type of job anywhere in India; have accommodation in Bombay, and in Indore (Madhya Pradesh); minimum gross salary in a suitable grade Rs. 500 per month plus T.A. and D.A., if the post is a touring one. (Office ref. E.S. 162).

YOUNG STUDENT, 26, passed Inter Science and Section A examination with electrical engineering, with 2½ years experience in wiring and inspection of switchgear and 6 months in moving coil instrument assembly and inspection, is available for training or employment. (Office ref. E.S. 163)

IGNORANCE IS NO EXCUSE

You may be an engineering student or working in an engineering department, knowledge of accounts is absolutely essential.

A TEXT BOOK OF PUBLIC WORKS ACCOUNTS **(with a chapter on Overseers' Duties)**

By S. C. Dikshit, C.E. Hons., P. G. Dip., A.M.I.E., M.I.A.B.S.E., Executive Engineer, with Foreword by Sri Jagdish Prasad, C.E., M.I.E., Chief Engineer, U.P., P.W.D. Second enlarged 1964 edition. It covers all important topics, e.g. new heads of accounts, cash, stock, T. & P., road metal, tenders, bills, rent statements, booking of expenditure, dealings with railways, T.A., Overseers' duties, book-keeping, etc. Contains many solved practical examples.

Covers the Syllabus of Diploma Courses of Assam, Bihar, Kashmir, M.P., Punjab & U.P. Highly useful for departmental examinations.

Some opinions about the book :—

" . . . . . The book is well written and the subject matter properly arranged. The illustrations given therein are very useful." J. Mukand, Chief Engineer, P.W.D. H.P. ...

" . . . . . I find that it is a very useful work nicely brought out and will be of immense help to staff and officers in the P.W.D. and go a long way to minimise audit objections if properly made use of." Md. Usman, Addl. Chief Engineer, Hyderabad. ...

" . . . . . There is one chapter among others, dealing with "Duties of Overseers" in this book which will be very useful to young Engineers as well as Overseers." S. N. Gupta, Chief Engineer, West Bengal, Calcutta.

" . . . . . This is probably the best available book on the subject." B. N. Vaish, Principal, Chandauli Polytechnic, Varanasi.

" . . . . . I have found it to be the best so far written on the subject." K. T. Jain, Principal, Handia Polytechnic, Allahabad.

Pages 350, Cloth bound, Price Rs. 10.50, Packing and postage extra. Descriptive literature free. For V.P.P.s., send Rs. 2.50 as advance.

SUBODH AND COMPANY

288, Kutchery Road, Lucknow.

INSTITUTION NOTICES

Sections A and B of the Associate Membership Examinations—Option to students to appear in the Old Scheme

It is once again notified for the information of candidates that they will not be permitted to appear for the **Old Scheme** of examinations to be held in November 1964, in Section A or B, unless they have at least one exemption to their credit. Candidates not fulfilling the above condition and submitting application forms for the **Old Scheme** of examinations will have their applications rejected.

Sections A and B of the Associate Membership Examinations—Limitation to number of candidates at examination centres

The Examinations Committee have decided that the number of candidates appearing at any examination centre should be restricted to 750 only, in view of the difficulties experienced in making arrangements.

Candidates intending to appear in the examinations should mention in the examination application form the name of three examination centres in order of preference, and the Controller of Examinations will allot to each candidate the centre at which he will be permitted to appear. Candidates who fail to mention more than one examination centre will be allotted any centre of examination at the discretion of the Controller of Examinations. No individual representations will be received after the allotment of the examination centre is made.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1964 Examinations

Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Studentship Examination	
Monday, November 9, 1964	English	Mathematics I
Tuesday, November 10, 1964	Mathematics II	Physics
Wednesday, November 11, 1964	Chemistry	
	Associate Membership Examination—Section A	
Monday, November 9, 1964	Mathematics I	Mathematics II
Tuesday, November 10, 1964	Applied Mechanics	Principles and Applications of Heat, Light and Sound
Wednesday, November 11, 1964	Principles and Applications of Electricity	Theory of Structures and Strength of Materials Theory of Machines Elementary Electrical Engineering Applied Chemistry Physical Chemistry and Organic or Inorganic Chemistry
	Associate Membership Examination—Section B	
Monday, November 9, 1964	Engineering Materials	Engineering Drawing I
Tuesday, November 10, 1964	Engineering Drawing II (from 10.00 a.m. to 1.00 p.m. and 1.30 p.m. to 4.00 p.m.)	
Wednesday, November 11, 1964	Theory and Design of Structures Diffusional Processes. Evaporation and Distillation Chemical Works Organization and Management	Electrical Engineering General Geology Fuels and Combustion
Thursday, November 12, 1964	Irrigation Water Supply and Sanitary Engineering Hydro-Electricity Agricultural Engineering Machine Design Mining Metallurgy Mechanics of Fluids	Thermodynamics and Heat Engines Metallurgy Transport and Storage of Materials Principles of Heat Transmission and Furnaces Soil Mechanics and Foundation Engineering
Friday, November 13, 1964	Workshop Technology Engineering Chemistry Electrical Installations Electrical Measurements Electric Traction Ultra-High Frequency Technique Including Radar and Centimeter-Waves Electro-Chemistry Industrial Stoichiometry	Building Construction Stability and Resistance of Ships Gas Engineering Principles of Mining Metrology and Machine Tools Electricity Supply Instruments and Automatic Control in Chemical Industry Chemical Works Design and Construction Size Reduction, Mixing and Separation
Saturday, November 14, 1964	Hydraulics and Hydraulic Machinery Roads Town Planning Harbours and Docks Architecture Line Communication Railways Power Generation and Distribution in Chemical Works	Electrical Machinery Geodesy Radio Communication Principles of heat Transmission, heat Transfer Equipment, and Refrigeration Materials and Mechanical Construction of Chemical Plants
Monday, November 16, 1964	Industrial Engineering and Management	Refrigeration and Air-Conditioning Aeronautics

Form 362

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1964 Examinations

General information and instruction to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961; and 58th Meeting, Resolution 10, 13th and 14th October, 1961.)

(1) The next Studentship and Associate Membership (Sections A and B) Examinations will be held from Monday, November 9, 1964 to Monday, November 16, 1964, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examinations and the programme of examinations are attached to this *Bulletin*.

(2) **All applications accompanied by examination fees for admission to the November 1964 examinations should reach the Head Office before 4 p.m. on Tuesday, September 15, 1964.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidates is specially drawn to item 4 in Form 304 (rev. 8) and item 5 in Form 305 (rev. 7) in this regard. The instructions for making such payment are given in card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

Mention the code no. as given in the top of the application form in the bank card or money order coupon.

(4) No application for a change of examination centre will be entertained after 4 p.m. on Tuesday, September 15, 1964.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B on payment of an examination fee of Rs. 30.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

(9) The paper in 'Engineering Drawing II' is of 5½ hours' duration, with a half-hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(10) Section B candidates should specially note to write down on the cover of their answer-books of the paper in 'Engineering Drawing II' the names of their particular sections, *viz.*, structural steelwork or reinforced concrete or machines or electrical or chemical plant.

(11) **Candidates are not permitted to use handbook(s) for the paper in 'Engineering Drawing II.' They may however use steel tables of the Dorman-Long type.**

(12) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be readmitted to the Institution at any future time.

(13) Candidates reappearing in subject(s) in which they have already secured exemption(s), will have their paper(s) cancelled. The previous exemption(s) will stand.

(14) It is sometimes found that candidates do not enter their Studentship Number/Studentship Application Reference Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(15) **The results of the November 1964 examinations will be declared before the last day of February 1965.**

(16) Candidates will be permitted to apply for the checking of their answer-books as to whether the marks allotted in the answer-books were added correctly and all the answers within the answer-books were appropriately marked, on payment of Rs. 5 as checking fees for each paper. Candidates wishing this check to be made should apply to the Controller of Examinations within 15 days of the date of posting the results by him.

(17) The marks of each examination will be communicated to candidates along with results free of charge.

(18) **The Institution reserves the right to cancel the result of any candidate without assigning reasons, in which case, the marks will not be supplied.**

(19) In any future correspondence in regard to the November 1964 examinations, candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in November 1964.

Form 362

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1964 Examinations (New Scheme)

General information and instruction to candidates

(Approved by the Examinations Committee, 51st Meeting, Resolution 21, 30th December, 1958)

(Revised by the Examinations Committee, 57th Meeting, Resolution 19, 27th-29th June, 1961, and 58th Meeting, Resolution 10, 13th and 14th October, 1961).

(1) The next Associate Membership (Sections A and B) Examinations (new scheme) will be held from Monday, November 9, 1964 to Tuesday, November 24, 1964, both days inclusive. The application forms for the Associate Membership (Sections A and B) Examinations (new scheme) and the programme of examinations are attached to this *Bulletin*.

(2) **All applications accompanied by examination fees for admission to the November 1964 examinations should reach the Head Office before 4.00 p.m. on Tuesday, September 15, 1964.** Examination fees once paid are neither refundable nor transferable to a subsequent examination or to any other account. Receipt of examination forms will not be acknowledged by the Head Office, unless accompanied by a self-addressed post-card.

(3) **Examination fees should be preferably deposited at the State Bank of India in the candidates' locality. Attention of the candidate is specially drawn to item 3 in Form 363 and item 5 in Form 364 in this regard. The instructions for making such payment are given in Card A (attached herewith) and on its reverse. Other modes of payment may be used only if this is not possible. Payment of examination fees by cheque will not be accepted.**

Mention the code no. as given in the top of the application form in the bank card or money order coupon.

(4) No application for a change of examination centre will be entertained after 4.00 p.m. on Tuesday, September 15, 1964.

(5) Students who are in arrears of subscription will not be admitted to the examinations.

(6) **The Institution reserves the right to reject incomplete or illegible applications without any reference to the candidate.**

(7) No Student will be permitted to appear in the Section B examination unless he has fully passed the Section A examination or secured exemption therefrom. A candidate for the Section B examination should therefore mention the year in which he passed the Section A examination.

(8) Students appearing for the Section B examination under the revised rules 17(a) to 17(i) of the rules of examinations (see Rules and Syllabuses of Studentship and Associate Membership Examinations) should clearly state in the application form the name of the Local Centre to which they are attached.

(9) A candidate who has already passed the Section A and B examinations or is exempted therefrom will be permitted to appear in any paper or papers of Section A and/or Section B (new scheme) on payment of an examination fee of Rs. 50.00 per paper. The details of passing the Section A and B examinations or of exemption therefrom should be clearly stated in the examination form, with the grade of membership.

A candidate may also appear in one complete branch of engineering on payment of usual examination fee of Rs. 75.00. Rules of examination for such a candidate will be identical with those applicable to regular candidates.

(10) The Design and Drawing papers are of 5½ hours duration, with a ½ hour recess between. Candidates will not, however, be permitted to leave the examination hall.

(11) Candidates are not permitted to use handbook(s) for the paper in 'Design and Drawing' of Section B. They may, however, use steel tables of the Dorman-Long type.

(12) Candidates detected using unfair means in the examination hall will be expelled from the Institution and will not be re-admitted to the Institution at any future time.

(13) Candidates reappearing in subject(s) in which they have already secured exemption(s), will have their paper(s) cancelled. The previous exemption(s) will stand.

(14) It is sometimes found that candidates do not enter their Studentship Number, Roll Number, or other necessary particulars on the answer-books. Such answer-books will be rejected and no attempt will be made to locate the candidates. Candidates should therefore take particular care to write down these particulars on the answer-books correctly.

(15) The results of the November 1964 examinations (new scheme) will be declared before the last day of February 1965.

(16) Candidates will be permitted to apply for the checking of their answer-books as to whether the marks allotted in the answer-books were added correctly and all the answers within the answer-books were appropriately marked, on payment of Rs. 5 as checking fees for each paper. Candidates wishing this check to be made should apply to the Controller of Examinations within 15 days of the date of posting the results by him.

(17) **The marks of each examination will be communicated to candidates along with results free of charge.**

(18) The Institution reserves the right to cancel the results of any candidate without assigning reasons, in which case, the marks will not be supplied.

(19) In any future correspondence, in regard to the November 1964 examination (new scheme), candidates should always mention the Section of the Associate Membership Examination in which they appeared and their centre of examination in November 1964.

THE INSTITUTION OF ENGINEERS (INDIA)

8 Gokhale Road, Calcutta 20

November 1964 Examinations (New Scheme)

Programme

Days	S.T. 10.00 to 1.00	S.T. 2.00 to 5.00
	Associate Membership Examination—Section A	
Monday, November 9, 1964	Mathematics I	Mathematics II
Tuesday, November 10, 1964	Applied Mechanics	Principles and Applications o Electricity
Wednesday, November 11, 1964	Heat, Light and Sound	Engineering Drawing
Thursday, November 12, 1964	Strength of Materials	Elementary Surveying
	Associate Membership Examination—Section B	
Monday, November 9, 1964	Materials and Construction Mechanical Engineering Materials Electrical Engineering Materials Chemical Engineering Materials Principles and Practice of Coal Mining Mineral Dressing Electronics and Telecommunication Materials	Theory and Design of Structure Industrial Organization an Management Theory and Performance o Electric Machines Industrial Stoichiometry an Mechanics of Fluids Principles and Practice of Meta Mining Physical Metallurgy and Physica and Mechanical Testing o Metals
Tuesday, November 10, 1964	Structural Engineering Generation, Transmission and Distribution of Electric Power	Surveying and Geodesy Theory of Machines Electric Traction
	Diffusional Processes, Evaporation and Distillation	Fuels and Combustion Mine Surveying
	Mine Ventilation, Explosions, Fire and Inundation	Foundry Engineering Transmission Lines and Net Works
	Refractories Applied Electronics and Circuits	
Wednesday, November 11, 1964	Hydraulics Industrial Engineering Illumination Engineering Elementary Electrical Engineering Mineral Dressing Practice Metallurgical Analysis Advanced Radio and Electronic Engineering	Irrigation Engineering Refrigeration Line Communication Gas Engineering Mining Geology Industrial Metallurgy Antenna and Wave Propagation
Thursday, November 12, 1964	Civil Engineering Design and Drawing Mechanical Engineering Design and Drawing Electrical Engineering Design and Drawing Chemical Engineering Design and Drawing Electronics and Telecommunication Design and Drawing	(From 10 a.m. t 1 p.m. and 1.3 p.m. to 4 p.m.)
	Mining Machinery Physics of Metals	Generation, Distribution an Utilization of Power in Mine Metallurgy of Less Commo Metals

Programme—(*Contd.*)

Friday, November 13, 1964	Architecture Air-Conditioning Radio Communication Materials and Mechanical Construction of Chemical Plants Mine Design and Planning Metallurgical Thermodynamics Radio Communication Systems	Soil Mechanics and Foundation Engineering Aerodynamics Hydro Power Engineering Metallurgy Mine Organization and Management Engineering Metallurgy Audio Frequency Engineering
Saturday, November 14, 1964	Public Health Engineering Railway Locomotives and Rolling Stock General Electronics Refrigeration and Air-Conditioning Mine Economics Electrometallurgy and Hydrometallurgy Electronic Measurements	Town Planning Automobile Engineering High Frequency Currents Chemical Works Organization and Management Metallurgy and Assaying Fuels and Furnaces Industrial Electronics
Monday, November 16, 1964	Highway Engineering Fuels and Refractories Radar Engineering and Microwave Techniques Workshop Technology	Harbours and Dock Drilling Engineering Television Utilization of Electric Power Principles of Heat Transmission and Furnaces
Tuesday, November 17, 1964	Thermodynamics and Heat Engines Size Reduction, Mixing and Separation Telegraphy and Telephony	Agricultural Engineering Thermodynamics Carrier Current Engineering
Wednesday, November 18, 1964	Metallurgy of Iron and Steel Industrial Administration	Geology Production Technology Non-ferrous Metallurgy
Friday, November 20, 1964	Railways General Mechanical Engineering	Water Power Engineering Electrical Measurements Heat Treatment of Metals and Alloys
Saturday, November 21, 1964	Thermal Power Engineering Servomechanisms	Production Technology and Industrial Engineering Principles of Semiconductors and Transistor Circuits
Monday, November 23, 1964	Principles of Line and Radio Communication	Hydraulics and Hydraulic Machinery
Tuesday, November 24, 1964	General Electrical Engineering	

A Symposium

on

ENGINEERING DESIGN AND DEVELOPMENT

is being organized jointly by

The Institution of Engineers (India), Kharagpur Sub-Centre

and

The Indian Institute of Technology, Kharagpur.

The Symposium will be inaugurated by Dr. T. Sen, M.I.E., President, The Institution of Engineers (India), on November 28, 1964, at 10.00 a.m. and will continue for three days.

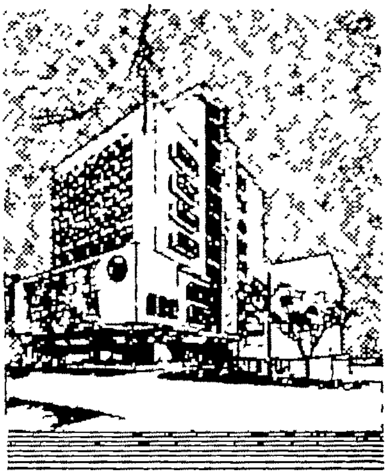
Manuscripts of papers to be presented at the Symposium should be sent to Prof. S. C. Das, A.M.I.E., Honorary Secretary, The Institution of Engineers (India), Kharagpur Sub-Centre, P.O. Kharagpur Technology, District Midnapore, West Bengal, so as to reach him at least 15 days before the commencement of the Symposium. Advance intimation from intending contributors stating the titles of the papers they desire to present at the Symposium should be given not later than November 1, 1964. The scope of the papers and the discussions at the Sympssium will be limited to one of the following aspects of any branch of engineering :

(i) Current trends in Designing Engineering Products and Projects

(ii) Evaluation of Engineering Projects Undertaken in India

(iii) Development in Engineering Materials and Manufacturing designs

(iv) Recent Researches and Their Relationship to Engineering Design



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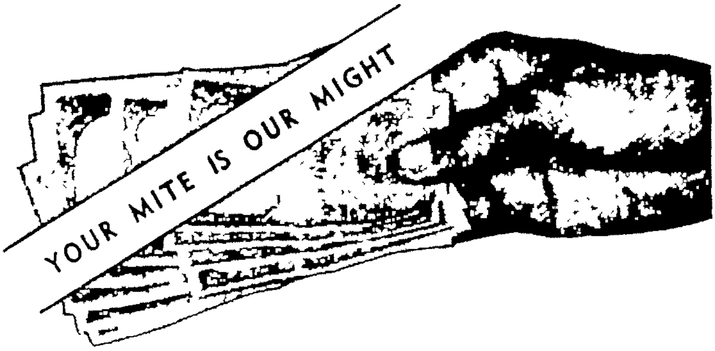
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THE BULLETIN

OF

The Institution of Engineers (India)

SECRETARY & EDITOR: B. Seshadri, B.Sc., A.I.I.Sc., D.I.C., M.Sc.(Eng.), M.I.E.

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THE IMPORTANCE OF TECHNOLOGY IN MANAGEMENT

Maj.-Gen. Pratap Narain
Member

Whatever be the outcome of the controversy whether management is an art or a science, there is little doubt that amongst the various qualities required of top managers there are three main subjects which today's managers must understand, *viz.*, (i) economics, (ii) human relations, and (iii) technical concepts of industry.

Whereas great stress has been laid on the training of managers in economics, and we are being flooded with literature on human relations from the U.S.A. and other advanced countries, it is felt that only lip-service is being paid to the need for utilization of scientific and technical advances. We are lagging behind in the understanding of technical concepts of industries and in the improvement of our techniques of production.

The understanding of economics in Indian management is of a high order. In fact, in the private sector enterprises of medium scale, the consideration bestowed to economic running of business and the larger aspects of expenditure to achieve economic production within the technical competence of the manager has been good. The area of decision in machine replacements is sometimes neglected due to the complexities of import restrictions and lack of understanding of machine replacement theories such as the MAPI formula ; and these result in the manager not being able to convince the directors who, in any case, are prone to eschew capital expenditure.

In the human and industrial relations fields also, we have a fairly high standard of performance. A great deal of attention is being given to the problem of getting the best of the human material, and their selection, organization, development and rewarding; and this is quite understandable, as this is one of the most important managerial duties. Work load analysis and the acceptance of productivity levels in this area, however, require a basic understanding of the technical aspects of the industry, as, without them, the cost of production can run away as has happened in many of our industries which are non-competitive in the world market. The general excuse that our costs are high on account of higher capital costs is untenable on analysis—it is the productivity from our labour which is by no means cheap, which finanally tips the balance.

Without an understanding of the technicalities of a particular industry, it is not possible to do justice in the above two fields, as it is only with an understanding of what can or cannot be achieved with men and machines that one can arrive at reasonable productivity levels and the work load analysis.

The scientific management and work study principles in the field of labour productivity, and the use of mathematical techniques to tackle management problems particularly in inventory control and accounting, etc. require an understanding of technology by the top management. Similarly, in the selection and utilization of the machines available for production processes, it is hardly possible to achieve success if one is dependent on the advice of the *mistry* whose knowledge is limited to old practices.

A dynamic manager must, in the present day context, have technical ability necessary in his field to enable him to be able to guide and lead his team.

Our particular problems

The reasons for our shortcomings in the technical field are many but the more important ones can be briefly stated as under.

Firstly, there is the lack of familiarity with the screwdriver and the spanner which has been the result of our neglect of technical education and our habit of looking down on manual work. Further, due to the want of gadgets, machines and mechanical contrivances in our country which is still dependent on imports, we do not get a chance to study or use such opportunities as are available to people living in industrialized countries.

Secondly, the pattern of our industrial development has been limited to three major industries, *viz.*, coal, cotton and jute and lately, it has extended to consumer industries such as steel, paper, sugar, matches, glass, vanaspati, soap, cement, etc. Most of these can be classed as product industries, where the questions of imported plants, consumer market, production planning, cost control, and sales, and other managerial problems are limited.

The technical problems are however looming large now that we have to build machines to survive, to build India. In the machine building field where technological problems arise, our equipment is totally inadequate as will be seen from the target and actual production figures given below for cement, paper and sugar plants in the private sector.

Plant	Annual target 1965	Actual 1962
	Rs. (in crores)	
Cement	4.5	0.90
Paper	7.0	0.48
Sugar	10.0	6.32

Thirdly, the management of industries in our country has in the past been largely based on birth; however, some of the Indian managing agency houses have been educating their own men in the engineering fields with particular reference to their present and projected product lines, but their education has been in many cases limited to acquisition of degrees and practical training to the extent of watching the operations of plants in the works of their collaborators. The British managing agents have, on the other hand, been recruiting technicians to run their complicated engineering industries, but have been finding it more and more difficult to employ them due to Government restrictions.

Lastly, there is a great emphasis in our country on degrees and diplomas. Some of the technically qualified persons are relegated to duties not requiring competence; and others are unable to make a headway due to lack of educational qualifications. The result has been that the few technicians we have, who know the machines, are blocked in a way and the educated men are happy to work in the offices. As a consequence, only a few managers understand the equipment they are ordering but even they have to generally wait for the machines to arrive and to be opened before knowing what to do with them.

Some suggestions

The changing of our system of education being a long term process, it is felt that we should develop managerial talent from the technicians who have a fair knowledge in the fields they are working even if they do not possess an educational background. Cross-fertilization of new graduates from universities and the more experienced practical men from within the industry will undoubtedly be of benefit to both types of entrants to the management cadres.

The other source available to us is the fairly large number of Indian technicians who are at present employed abroad, but are reluctant to return to India due to lack of opportunities and the colour prejudice which debars them from getting the same emoluments as are being paid by us to foreign nationals only.

Training facilities

Difficulties of foreign exchange is one of our greatest difficulties in offering training facilities to more men but any money which is spent judiciously in training the technical side of our managers is well spent. Availability of foreign exchange for purchase of books, etc., provision of increased opportunities for training with the aid of the National Productivity Council, etc. and through Government scholarships, easing of controls on technical personnel proceeding abroad for training, etc., only these will ensure us of the men we want.

There are however many ways of training personnel within the country but these are perhaps not fully exploited, *e.g.*, arranging meetings of senior managers and directors, and holding short courses and discussions to bring to them the latest advances; follow-up training of middle managers to further their education and to keep them informed of the advances in science and technology, etc. We have several organisations which are actively engaged in management training who can arrange some of the above.

In our country, two institutions of higher management training have been developed, at Calcutta and at Ahmedabad, but it is not known whether they are connected with our universities in their working. Some advance is being made in the integration of technology with management training at the Indian Institutes of Technology at Kharagpur and Delhi and perhaps at some other Institutions also. It is time we take stock of our management development and training programmes and give them the emphasis needed for the future.

TEACHING OF CONTROL SYSTEMS ENGINEERING

M. Sinha
Non-member

Introduction

The reign of automation, computation and control has begun. Development of control systems engineering during the last two decades has spotlighted the need for the study of control systems engineering in our country also. Control engineering knows no classical boundaries on departmental lines such as electrical, mechanical, etc. but it aims to combine knowledge and techniques from diverse fields. As a matter of fact, automatic control engineering has been influencing and producing modifications in all branches of engineering. While offering control systems engineering as a subject to students, the diverse aspects of engineering applications must be borne in mind and a balanced and uniform syllabus embracing fundamental knowledge must be prepared.

The courses should plan techniques to overcome the terminology barriers and teach analogous methods of component descriptions and system performance evaluation. The student must be made well-versed in mathematical techniques to understand the analysis and design of the systems. At present, practically nothing is being taught of control engineering at the under-graduate level. It is better to start teaching at the post-graduate levels.

The student who takes up the study of control systems must possess a knowledge of the methods of transform, *viz.*, Fourier and Laplace particularly. Statistics, complex variables and differential equations are also important prerequisites. A knowledge of the information theory, electronics circuit analysis and semi-conductor electronics is also necessary.

Subjects for the course of study

Concept of feedback control

Here the distinction between open-loop and closed-loop must be explained by taking appropriate examples from the various fields of engineering. Emphasis must be given on the importance of physical understanding. The next step would be the derivation of equations that represent physical systems mathematically. The nonlinear concept need not be introduced at this stage. The course may start with electrical circuits and methods of drawing electrical circuits analogous to mechanical and electromechanical systems. This approach will be advantageous because a complex system can be set down using convenient symbols in the form of electric circuit diagrams from which the behaviour of the system can be analyzed with comparative ease.

Once the circuit diagram analogous to the given system is drawn, the prediction of its behaviour may be determined by inspection only. The mathematical treatment may be handled in a manner which will tailor it for direct use by the control system engineer.

Analysis and transfer function

Methods of solving differential equations have to be explained to the student. The classical method of approach in terms of poles and zeros is an essential feature. Stress has to be given on the transfer function method of analysis. The ideas of superposition and the related topics must be explained along with generalized handling of the initial conditions. For understanding the transfer function method of analysis, the Laplace transform method of solving linear differential and intergrodifferential equations is very important. The inverse Laplace transform including that by the pole-zero location method must be taught. When the Laplace transform method cannot be used converniently to solve linear differential equations with variable coefficients even of the first order, the classical approach, it must be made known, can yield solutions to many such equations. Also, when the general solution of the system equation by the classical method is separated into a complementary function and a particular integral, the understanding of the system is simplified. The third point to be noted is that if the known conditions of a problem are specified at values of the independent variable other than zero, the Laplace transform method becomes cumbersome even when the physical situation can be described by differential equations with constant coefficients. On the other hand, the application of the classical method is not modified by the way in which the known conditions are specified. These are some of the merits and demerits of the two methods of analysis, and the teaching of these two methods is important.

Charts and curves must be introduced to allow ready identification of transient response. Compensation procedures such as error rate and output rate damping in time domain must be explained at length. By means of simple examples, the correlation between steady state frequency response and the corresponding dynamic behaviour in time domain must be shown. Then the student should be taught the transfer characteristics of basic operational functions simultaneously in terms of their (i) pole-zero pattern, (ii) polar plots, (iii) magnitude *vs.* log frequency plots, and (iv) log modulus and phase *vs.* log frequency plots. This should be, in general, independent of the character of the components, be they electrical, mechanical, pneumatic or hydraulic. Generalized charts and figures must be included for ready use in design procedures. The transfer function of components from different engineering fields such as electrical networks, amplidynes, motors, amplifiers, missiles, gyroscopes and stabilized platforms for inertial navigation, etc. must be explained. The relationship between damping ratio and phase margin must be explained for providing correlation between steady state sinusoidal frequency response and dynamic time domain behaviour.

Stability and compensation

The study of system stability by the Nyquist criterion must be explained. The stability criterion by considering the Bode diagram and the concepts of gain margin and phase margin have to be discussed. Then should follow stability analysis using (i) root-locus method, (ii) Routh criteria, and (iii) root location of the characteristic equation. For explaining the Nyquist criterion, the 'contour mapping' method has to be introduced. The relationship between damping ratio and phase margin must be included in the course of study.

System design in the background of a knowledge of stability in the domain of frequency has to be studied by starting with the statement of the problem in terms of meeting the proposed requirements. Complete compensation design taking all types of compensation (series, parallel, lag, lead and compound) has also to be studied. The development of the relationship to relate a frequency domain quantity, *i.e.*, phase margin, to a corresponding time domain quantity, such as the predominant time constant of the compensated system, must then follow. A careful discussion detailing the useful areas of each type of compensation is necessary.

Design of system

The design of complete control systems according to given specifications must be done using complex frequency domain techniques. Students should get a clear idea in regard to transition from sinusoidal frequency to complex frequency and its advantages in design. Designs using the root-locus concept for negative and positive values of open-loop gain as well as poles and zeroes located in the left- and right-half s-plane must be considered. Use of spirule in the design of systems is a very important part of teaching. A critical study should be made to reveal how the root-locus approach furnishes information about frequency response and the time domain behaviour. Discussion has to be carried out to show the influence of introducing zero in the closed-loop transfer function on the dynamic behaviour of the system in the time domain. For obtaining information on the critical point of the system behaviour, a comparison with other methods such as Routh-Hurwitz and Nyquist should be given.

The pole-zero design techniques and the synthesis of *R-C.* networks as demanded by design compensation specifications should be taught. This will make the root-locus method more comprehensive. The question as to how the placement of poles and zeroes in the complex frequency plane affects both the form and the value of the element of the compensation network has to be observed by study. Different techniques for determining *R-C.* networks from the zero-pole pattern of the transfer function should be developed. The procedure of frequency scaling as well as impedance level shifting should be presented, if possible.

Computers and their use in control system design

First of all, the fundamental principles of the Boolean algebra including the mathematics of binary units are essential. Then the principles of analogue and digital computers should follow. Next the computer approach to the analysis and design of feedback control systems should be made clear. If possible, the role of the computer in the study of the dynamic behaviour of a control system in which nonlinearities are important must be stressed. The generation of nonlinear functions and multiplication and division by variables should be described. Other applications of the computers must also be explained.

Special topics

Lastly, an introduction to sampled-data control systems, nonlinear analysis, and self-adaptive control systems must be given. The treatment must be basic, associated with the various viewpoints used in designing such systems. Examples of spaceships and guided missiles and other systems should be explained to emphasize the importance of the self-adaptive control, which may be described as the control system of the future. An introduction to cybernetics with examples may also be given.

Laboratory work

Experiments on transient response study, Nyquist plot, transfer function analysis, synthesis of compensation networks, magnetic amplifier, differential gear, determination of the transfer function of a motor, root-locus plot of a given forward transfer function, Bode diagram of a given function, use of *M* and *N* circles, spirule, etc. may be set-up. The transistor is becoming popular in the field of control engineering and a few experiments on this may be carried out. Exact suggestions as to the course will depend on the overall facilities available in the particular institution which is contemplating a course of study in systems engineering.

Conclusions

Students are attracted by a particular branch of engineering when they are convinced that they will secure suitable jobs after qualifying as engineers. The Government, the industry and the engineering institutions in the country must try to create conditions that attract brilliant students to take up a course in control engineering. This branch of engineering is expanding very rapidly and we should not lag behind in acquiring greater knowledge in this field.

It is equally important to realize that research work in the field of control engineering must be taken up in our country, and a start can be made on such problems which can be solved without computers.

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Contemporary World Engineering Projects Series—26

Members are invited to contribute to this Series special articles featuring major engineering projects with which they may have been associated in any manner. Articles should be preferably accompanied by photographs and illustrative sketches.

TIDAL POWER STATION ON THE RANCE RIVER*

The tidal power station on the Rance River in France is now under construction. This article summarises the principles on which this plant functions. It is the first of its type in the world and the article gives information on the methods of building the dam and the principles underlying the design of the 'bulb sets', a new type of machinery which is to be used here and which is destined to enjoy a brilliant future in the development of low heads. After twenty years' research, tests and experiments and, in particular, after the operation of a 9 MW pilot plant in a disused lock at the Port of St-Malo, the carrying out of such a development as the Rance tidal power project is fascinating to follow.

Operational principles of a tidal power plant

A tidal power station obtains its energy from the range of the tides, that is to say, the difference between the level at high tide and the level at low tide, from the frequency of the tides (which is not identical throughout the world), and from the volume of water thus displaced.

A tidal power station can operate according to several principles :

Single action on emptying reservoir : On the flow tide, the reservoir is filled by opening the sluice gates. At high tide, these gates are closed and the reservoir is not emptied by the turbines until the outgoing tide has created an adequate head. This is the simplest type of operation formerly used in tidal mills (Fig. 1). Time tables permitting, it can be improved by using the electric power available on the system during slack hours to pump the water from the sea and discharge it behind the dam so as to raise the level in the reservoir and increase the volume of water available for the turbines later.

Single action on filling reservoir : In this case, the energy is generated by passing the water from the rising tide from the sea to the reservoir. This process is usually less satisfactory than the previous one, but it can also be improved by pumping to lower the level in the reservoir before the water passes through the turbines.

Two-way action : This is a combination of the two previous cycles (Fig. 2). Energy is generated both on filling and on pumping the reservoir, the turbines developed for the Rance River being able to operate in both directions, thanks to the modification of the orientation of the turbine wheel blades and guides. Here again two pumpings are possible.

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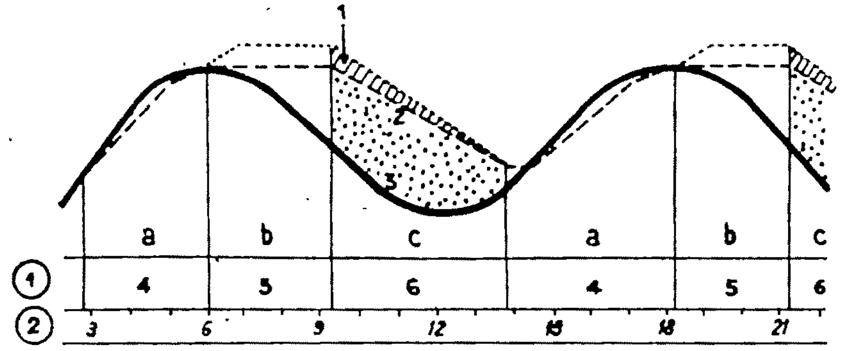
* Compiled from an article by R. Gibrat, published in the *French Technical Bulletin*, no. 2, 1962.



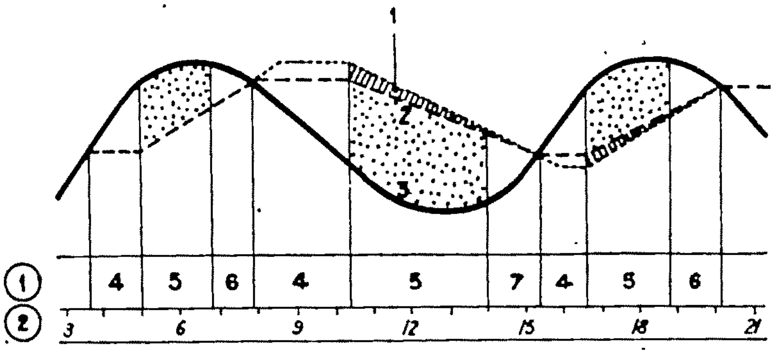
① Phases ② Hours

1 *With pumping*
2 *Reservoir level*
3 *Sea level*

4 *Filling*
5 *Standing or pumping*
6 *Water passing through the turbines*

Fig. 1

Single acting on emptying



1 *Phases*
2 *Hours*
3 *With pumping*
4 *Reservoir level*
5 *Sea level*

6 *Standing*
7 *Water passing through the turbines*
8 *Filling*
9 *Emptying*

Fig. 2

Double acting

It goes without saying that the choice of cycles is not governed by any hard and fast rules but varies according, on the one hand, to the strength and times of tidal movements and, on the other hand, to the load demand and the quantities it represents at various times during the day, *viz.*, peak hours, full capacity hours or slack hours.

The flexibility of operation ensured by double action and pumping enables 'operation cut to measure' to be obtained, which is almost completely independent of the rhythm of the tides, the lunar rhythm of which is abandoned to approximate more closely the solar rhythm which is that of human activities.

The Rance tidal development

The utility of a tidal development site is dependent firstly on the extent of the tide and, secondly on the size of the reservoir which can be created. It is also certain that, from the economic point of view and the size being equal, a reservoir will be all the more satisfactory as the length of the dam necessary to isolate it from the sea becomes less.

As far as the tidal range is concerned (difference in level between consecutive high tide and low tide), the Brittany coasts of the English Channel are among the most propitious in the world, thanks partly to the Cotentin Peninsula which forms an obstacle to the tidal wave coming from the Atlantic.

In the Rance Estuary which flows into the English Channel between St.-Malo and Dinard, the tidal difference in level may reach 44 ft. 4 in. (+ 13.50 m. above the zero of marine charts). The equinoctial tides, the highest of the year, displace of the rising tide and also of the ebb tide as much as 6,356 million c.ft. (180 million m.^{3}) of water or a flow of some 635,600 c.ft. (18,000 m.^{3}) per sec.

As far as the cycle of the tides is concerned, *i.e.*, their frequency, the choice of the Rance River is justified because its tides are semi-diurnal type—two high tides and two low tides in 24 hr. 50 min. or the length of a lunar day. This rhythm enables the most satisfactory efficiency to be achieved. The area of the reservoir constituted by the estuary is 8.5 sq. miles (22 km.^{2}). It extends to the Le Chatellier Lock near Dinan (Fig. 3) over some 12.5 miles (20 km.) and its working volume amounts to nearly 6,500 million c.ft. (184 million m.^{3}).

Structures

The Rance tidal power plant will be situated between the Brebis Head (left bank) and Briantais Head (right bank). At this spot, about 2.5 miles (4 km.) from its mouth, the Rance is about 0.46 mile (750 m.) wide and the greatest depths are 39.5 ft. (12 m.) below the level of the lower tide.

The development will comprise four distinct parts from the left to the right bank : one lock ; the power station ; a dyke ; and lock gates (Fig. 4).

(*a*) *The lock*

This lock, which will enable navigation to continue on the Rance Estuary, will be 43 ft. (13 m.) wide and 213 ft. (65 m.) long. The lock gates will be vertical shaft sector gates.

(*b*) *The power station*

Situated in the deep part of the Rance River, the plant will open up before visitors to the interior like a vast reinforced concrete tunnel about 1,213 ft. (370 m.) long. Each of its two linings, stiffened every 43.5 ft. (13.30 m.) by buttresses, takes in its turn the water pressure engendered by the tidal rhythm. The roof is vaulted. A cross-section of the plant is shown in Fig. 5.

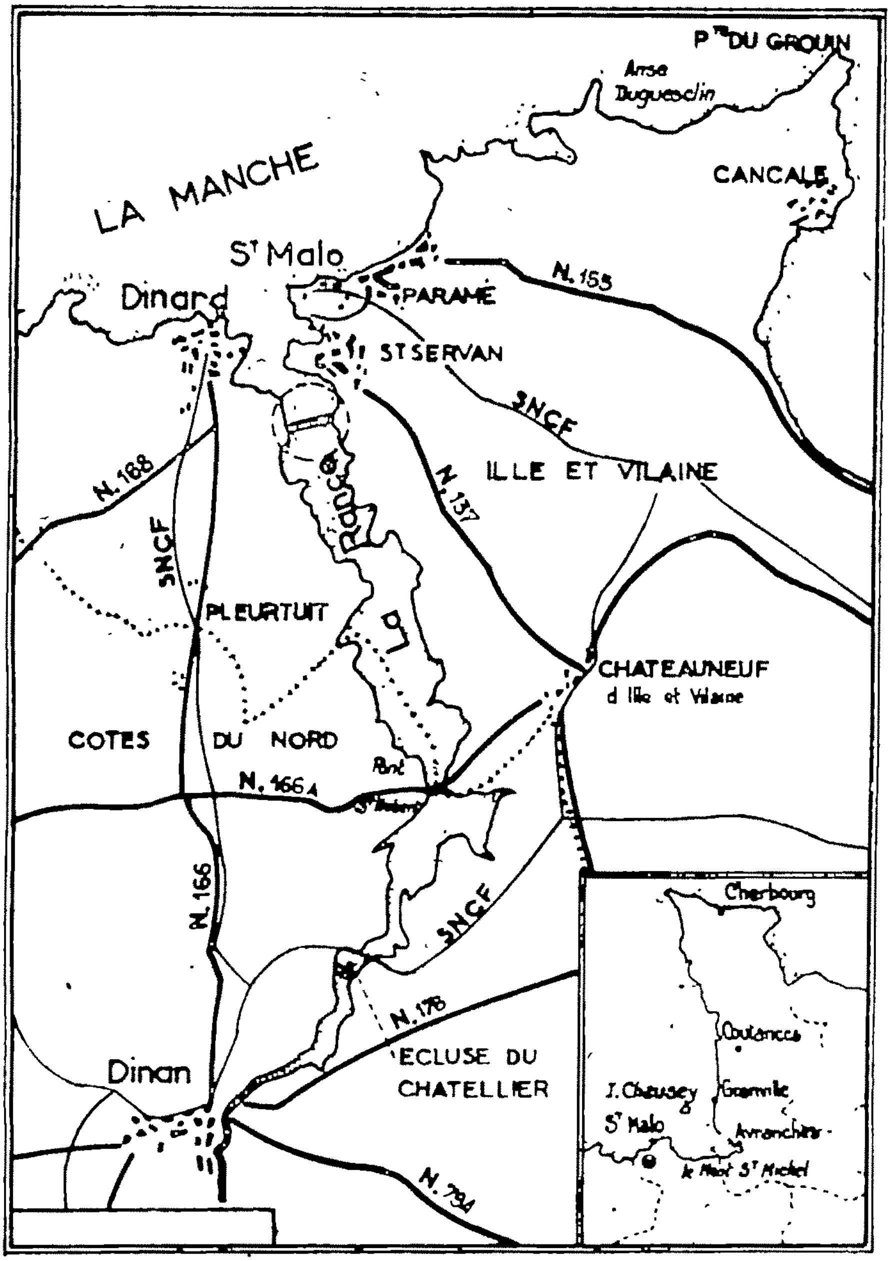
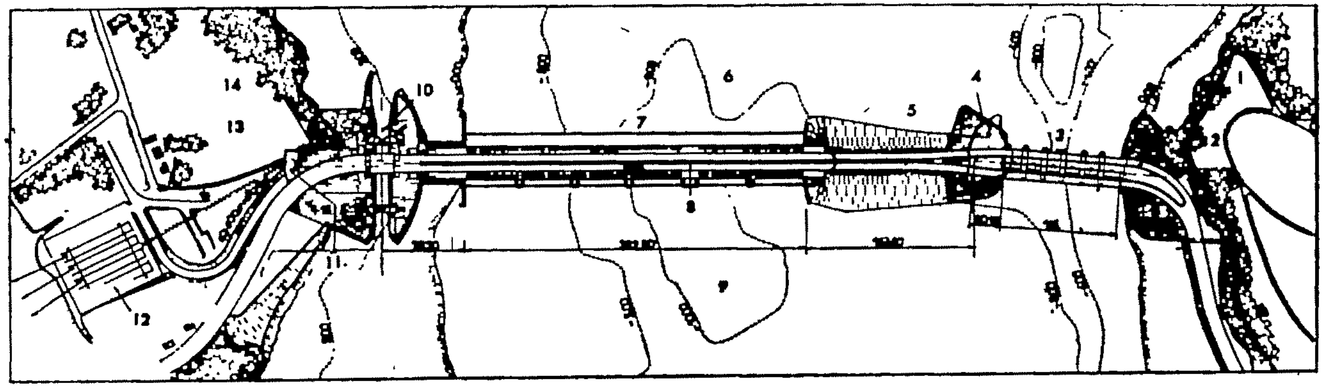


Fig. 3

Site map



1	Right bank	6	Sea	11	Access shaft to equipment
2	La Briantais head	7	24-set plant	12	225 Kv substation
3	6-gate mobile dam	8	Control room	13	La Brebis head
4	Chalibert island	9	Reservoir	14	Left bank
5	Dyke	10	Lock		

Fig. 4
General plan of development

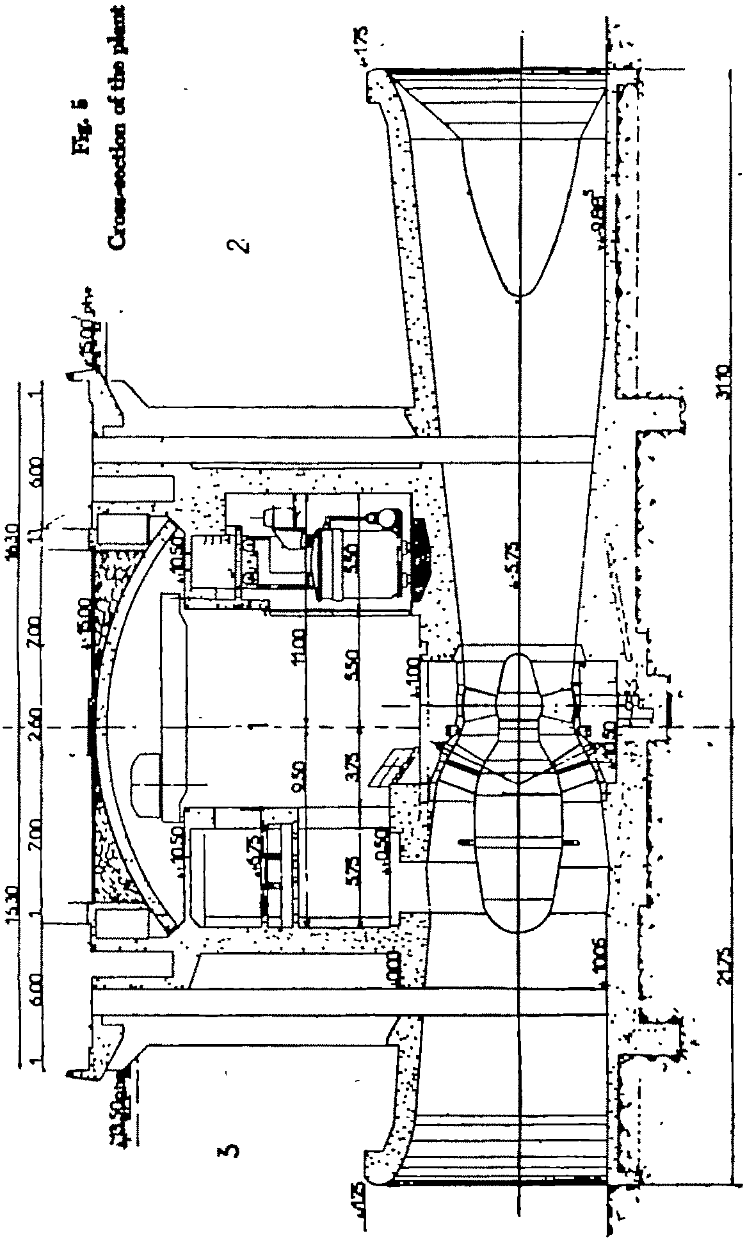


Fig. 5
Cross-section of the plant

1 Axis of plant 2 Tide side 3 Réservoir side

The plant will comprise twenty-four 10,000 kW sets. Each set, installed in a bay 43.5 ft. (13.30 m.) wide. will be placed in a pit of which the bottom will be situated at about —33 ft. (—10 m.) level.

For the operation, the 24 sets will be coupled in three blocks of eight sets, each block feeding an 80,000 kVA transformer inside the plant.

Oil-filled cables of 225 kV will connect the transformers to the outside outgoing substation on the left bank at about 984 ft. (300 m.) from the western end of the plant. Access to the interior of the plant for bringing in large items of equipment will be by a shaft installed on the left bank, which will be 72.25 ft. (22 m.) deep; this shaft will be extended by a gallery which will pass under the lock and open into a reception bay served by the travelling cranes of the machine room.

(c) *The dyke*

A dyke about 524 ft. (160 m.) long will separate the end of the plant from the Chalibert Island. It will be made of rockfill and will have a watertight concrete diaphragm.

(d) *Lock gates*

Between the Chalibert Island and the right bank, there will be a mobile dam (lock gates) comprising six passes enclosed by flat gates, about 50 ft. (15 m.) wide and 33 ft. (10 m.) high. These gates will enable the reservoir to be completely filled or emptied.

All the structures will be at the same level, *i.e.*, 50 ft. (15 m.) level above zero on marine charts. The crest will not only serve to crown the structures, but will carry the main traffic roads.

A section of the plant along the axis of a lock gate is shown in Fig. 6.

The bulb set

The sets with which the tidal power plant of the Rance River will be equipped will be of the 'bulb' type; this will enable water to be passed through the turbines in both the directions, *i.e.*, tide-reservoir and reservoir-tide, and it will also permit pumping.

As early as 1952, after thorough study of a project comprising conventional Kaplan sets in which the water passes through the turbine in a single direction only, the Electricite de France desired turbine and alternator manufacturers to study this problem from a new angle.

The bulb set is like a small submarine in appearance (Fig. 7). It has an ogival steel shell which contains the alternator and the Kaplan turbine. Placed in a hydraulic duct, it is entirely surrounded by water, access to the interior being had by a shaft opening into the power plant.

Experiments were first made with machines of this type on various rivers, at Cambeyrac on the Truyere River (two 5,000 kW sets), at Argentat on the Dordogne River (one 14,000 kW set), and at Beaumont-Monteux on the Isere River (one 8,500 kW set). Nevertheless, to complete the data thus obtained, it appeared to be of interest to experiment with a bulb set under the influence of the tides of the sea. This was done in a disused graving dock in the Port of Saint-Malo.

It is a small veritable tidal power station operating thus for the first time in any part of the world. The reservoir is constituted by the port basins and the tide is the same as that encountered in the Rance River.

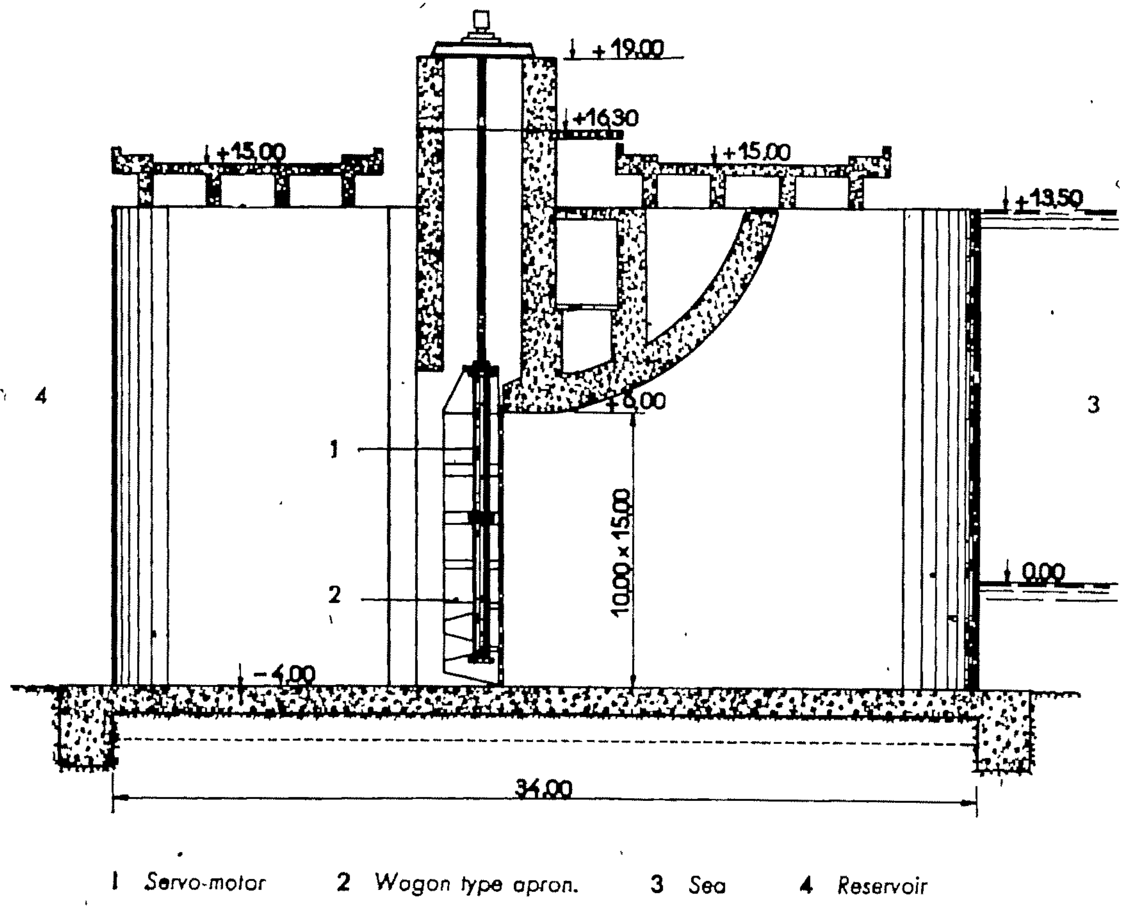


Fig. 6
Section of the plant along the axis of a lock gate

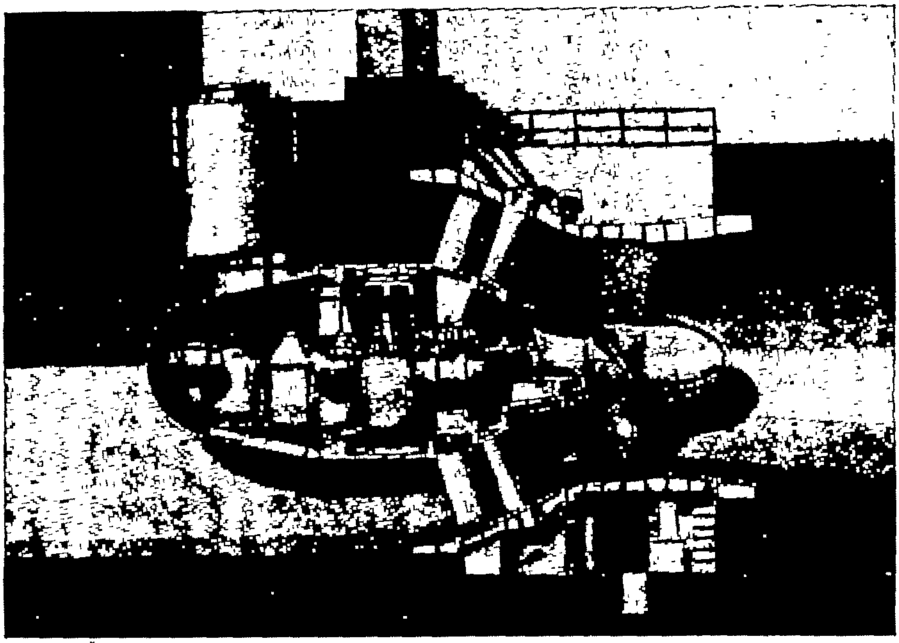


Fig. 7

A bulb set at the Rance tidal power station

The capacity of a Saint-Malo set is 9,000 kW at a speed of 88 r.p.m. The turbine is a Kaplan with mobile blades and guide vanes. The wheel diameter is 19 ft. (5.80 m.). The turbine is coupled to an alternator with an outside diameter of 16.5 ft. (5 m.) which revolves inside its ogival housing in air at atmospheric pressure.

The guide vane rings serve to carry the set inside its duct. The set can operate either as a turbine or as a pump in both directions of flow between the sea and the port basins.

A vertible test bench for a tidal generator set, the Saint-Malo plant yielded valuable information for the development of the sets which will finally be installed on the Rance River.

As a matter of fact, the Rance sets are only slightly different from the Saint-Malo set. Their capacity will be slightly higher, *i.e.*, 10,000 kW instead of 9,000 kW. This increase was made possible by operating the alternator in a slightly over-pressurized atmosphere, *viz.*, 28.44 lb. per sq. in. absolute (2 kg per cm.^{2} absolute), which permits improved cooling of the machine.

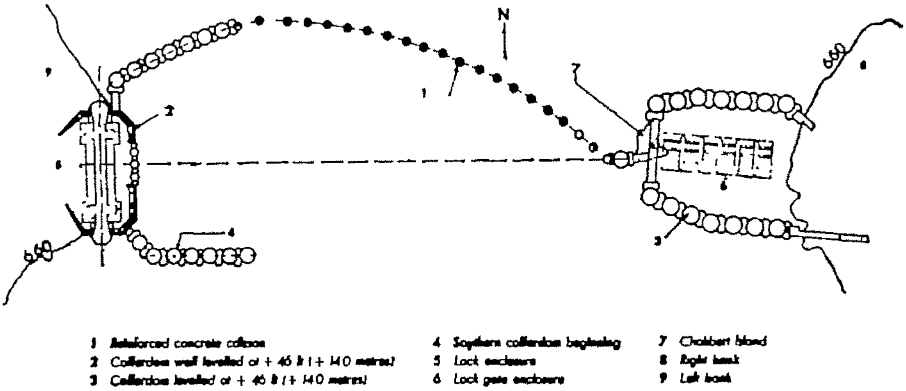
The wheel will also be slightly smaller, 17 ft. 7 in. (5.35 m.) in diameter instead of 19 ft. (5.80 m.), and will revolve at 94 r.p.m. instead of at 88 r.p.m.

Execution of engineering works

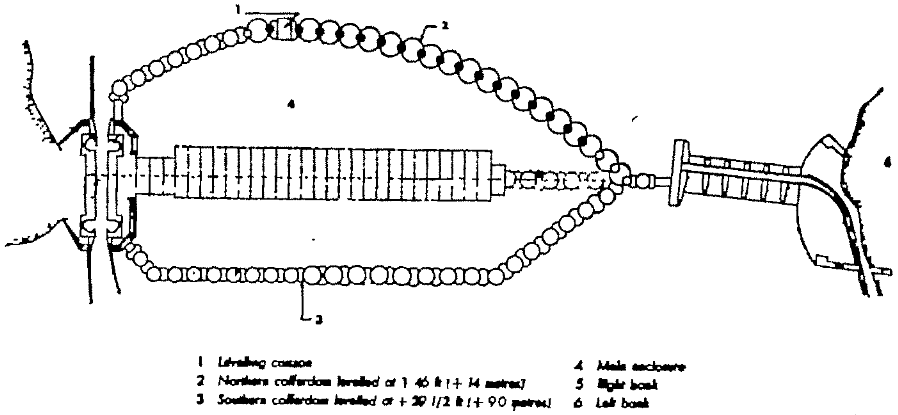
The structure will be erected in dry surroundings inside three cofferdam enclosures. The difficulty encountered here lies in the extent of the tide and the currents it produces, sometimes in one direction, sometimes in the other. A dam has to be set up in a river which floods daily, the discharge of which may reach 635,600 c.ft. (18,000 m.^{3}) per sec., both at the flood tide and the ebb tide, at the periods of high equinoctial tides.

Moreover, the design could only be studied on a reduced scale model. Two models of the Rance plant were made, one in Grenonle, by the Sogreah Laboratory, and the other on the Terre-Plein du Naye, at the edge of Saint-Malo-Saint-Servan Port, by the National Hydraulics Laboratory of Chatou. The tides were faithfully reproduced on these models, so that the best method of execution and adjustment could be studied (Fig. 8).

In the first phase begun since the end of 1960, two enclosures were taken in hand which have now been completed : the left bank enclosure to enable the lock to be built ; and the right bank enclosure bearing on the Chalibert Island to enable the lock gate dam to be built.


N
1
2
3
4
5
6
7
8
9
1 Reinforced concrete caisson
2 Cofferdam wall levelled at + 46 ft (+ 14.0 metres)
3 Cofferdam levelled at + 46 ft (+ 14.0 metres)
4 Southern cofferdam beginning
5 Lock enclosure
6 Lock gate enclosure
7 Chalibert Island
8 Right bank
9 Left bank

First stage


1
2
3
4
5
6
1 Levelling caisson
2 Northern cofferdam levelled at + 46 ft (+ 14 metres)
3 Southern cofferdam levelled at + 29 1/2 ft (+ 9.0 metres)
4 Main enclosure
5 Right bank
6 Left bank

Second stage

Fig. 8
Cofferdam work

The left bank enclosure consists of concrete walls erected at high tide and designed to be incorporated for the most part in the final lock works. The right bank enclosure is composed of cylindrical steel gabions 62 ft. 6 in. (19 m.) in diameter and 49 to 66 ft.

(15 to 20 m.) in height, connected with each other by arches. These gabions and their arches made of plate-web piling are filled with sand.

During the construction of the dam and the lock, work will be initiated on a third enclosure—the central enclosure—comprising two cofferdams, north and south, inside which the tidal power station will be erected.

It will be the northern cofferdam, situated at the side nearest the sea, which will 'cut out' the Rance River, that is to say, isolate its estuary from the sea. Very special care had to be taken in planning its erection because, side by side with the progress of the works, the breach left for the passage of the tide will become smaller with resultant differences of level and consequently stronger and stronger currents.

Several possible methods have been contemplated. It was finally decided to create reinforced points to take these strains between the beginnings of the enclosures in the steel gabion piling by stranding, at every 70 ft. (21 m.), heavy reinforced concrete piles, 300 ft. (9 m.) in diameter and from 59 to 79 ft. (18 to 24 m.) high on the foundations already prepared, by means of a compressed air caisson enabling work to be carried on under water.

The spaces between the reinforced concrete caissons will subsequently be closed by two sheet piling arcs which will form a cell to be filled with sand. It will be noted that the dam sluice gates can then be put into service and constitute a large outlet for the tide, thus relieving the stresses on the reinforced concrete caissons.

Once the river Rance has thus been cut off, the dam gates will be closed and the estuary will be converted into a lake unaffected by the movements of the sea. The surface of the water will be maintained at —28 ft. (—8.5 m.) level (marine charts), which is sufficient to permit navigation on the Rance River.

The southern cofferdam of the large enclosure, consisting of sheet gabion piling filled with sand, will thereupon be constructed in calm water.

Work on the main structures was begun in January 1961. It necessitated roughly 14,125,900 c.ft. (400,000 m.^{3}) of earth removal, 10,594,400 c.ft. (300,000 m.^{3}) of concrete, 10,000 (metric) tons of steel for reinforcement, and 968,750 sq. ft. (90,000 m.^{2}) of sheet piling curtains corresponding to 13,000 (metric) tons of steel.

The power station will generate 544 million kWh for an installed power of 240,000 kW (twenty-four 10,000 kW sets).

Powerful machinery has had to be put to work to achieve this task. Modern earthmoving equipment is working side by side with conventional cranes and a whole fleet of tugs, barges, sheer lighters and dredgers. A six-ton swivelling cableway sweeps over the area of the working site; and the span between the two 279 ft. (85 m.) high towers is 3,280 ft. (1 km.) long.

The erection of this tidal power plant which, in a few years, will, for the first time in any part of the world, add its production of energy to that supplied by hydraulic, thermal and nuclear power stations is of intense interest.

The main items of civil engineering adopted for this structure, the work already completed and the present state of progress will be published in a subsequent issue of the *Bulletin*.

ADDRESSES OF CHAIRMEN AT THE ANNUAL GENERAL MEETINGS OF THE LOCAL CENTRES

Orissa Centre

Chairman's address by Shri S. S. Behera, M.I.E., at the 5th Annual General Meeting of the Centre on March 8, 1964

After welcoming the Chief Guest, Shri Biren Mitra, Chief Minister of Orissa, and other invitees, Shri Behera thanked the Committee of the Centre for electing him Chairman for 1963-64. He referred to the patronage extended by the Government in granting Rs. 2,00,000 for the construction of the Local Centre building at Bhubaneswar which is expected to be completed by the end of this year, and thanked the Chief Minister for all the help he had extended.

Delivering the Chairman's address, he said, 'The long term plan for communications in the State of Orissa includes development of transport, ports and tourism and covers a period up to 1976, beginning with the commencement of the Third Five Year Plan.

During the Third Plan, improvement to 572 miles of existing roads, construction of 30 miles of new road and completion of 39 bridges were made possible at an expenditure of Rs. 5.8 crores.

At the beginning of 1961, the State had altogether 29,434 miles of road of all categories. With the implementation of the Long Term Plan, the mileage at the end of the Third, the Fourth and the Fifth Five Year Plan periods will be 29,478, 32,718 and 35,290 miles respectively.. The financial implication arising out of the construction of bridges and new roads, including improvement to existing roads, will involve an expenditure of Rs. 7.5 crores in the Third Plan, Rs. 87.6 crores in the Fourth Plan and Rs. 58.6 crores in the Fifth Plan, With the completion of the Long Term Plan, we will have a road density of 58.7 miles per 100 sq. miles at the close of 1976.

Besides development of communication, the Long Term Plan envisages the growth of transport including ports and tourism. It has been suggested in the Techno-Economic Survey Report that the road mileage operated by nationalised and rationalised transport undertakings is likely to rise from 5,000 miles to about 14,300 miles during the period mainly in Puri, Sambalpur and Ganjam zones and the total mileage of road that will come under stage carriage transport will be nearly 20,000 miles. As regards development of goods transport, the statistics available show that 5,000 trucks existed at the beginning of 1961. According to the Techno-Economic Survey, the number of trucks is expected to double in every 5 years till 1976 when as many as 40,000 trucks will be on the roads to cater to the needs of goods transport. Thus, it would be seen that the road system at the end of the Long Term Plan will be required to transport goods to the tune of 3.3 lakh tons per mile during the year.

The above trend of increase in the transportation of goods does not take into consideration the transportation of iron ore to the ports which will be shared by the Expressways and the railways.

Under the Long Term Plan, there is no definite plan programme for the railways. At present, only improvements in the capacity of the existing railway lines have been undertaken. It is however gratifying to note that the Ministry of Railways, Government of India, have undertaken survey for the future development of railways in the State in respect of the Nayagarh-Paradeep and Talcher-Tikerpara lines. Since large areas of the State remain undeveloped, the State Government has made a suggestion to the Railway Ministry to open railway communication between Cuttack and Sambalpur, Talcher, and Barbil and Bisiamcuttack to Cuttack or Berhampur. These places when connected with railway will reduce the avoidable long haulages by road transportation.

The construction of the Paradeep port is meant to promote the total economy of the State as it will provide for overseas trade and commerce as also employment to several thousands of men after it begins to function by October 1965. The present estimate of export through this port is confined to 5 million tons of iron ore, one million tons of rice, about one-half million tons of other indigenous goods, and one million tons of coal, with an ultimate export capacity of 14 million tons. The port is expected to earn a revenue of Rs. 5 crores annually.

Orissa has in the past several centuries displayed its perfection not only in the field of art but also in engineering as evidenced in the Konarak and Bhubaneswar temples. It has provided ample scope for the growth of tourism in the State. With a view to providing better amenities for tourists, the State Government has already constructed tourist bungalows at Puri, Konarak and Bhubaneswar. The Central Government have assured financial aid for the establishment of two categories of tourist bungalows in the State. Besides, the State Government has drawn up a tentative programme for putting up some tourist bungalows, commonly known as *Panthanibas* in all places of tourist interest for the benefit of tourists in the low income group.

It is worthwile here to mention the two major road projects on hand, *viz.*, the Expressway and the National Highway, that are now in progress. The salient features of the Expressway project comprise the construction of 10,300 running ft. of major bridges, 5,700 running ft. of minor bridges and 2,500 running ft. of culverts including construction of 88.5 miles of road having two traffic lanes from Daitari to Tomka mining areas to Paradeep port. The project is estimated to cost Rs. 14.15 crores. In addition, there is a scheme for lighting the entire Expressway at a cost of Rs. 1 crore so that heavy duty trucks can ply on it without using head lights at night At present, the bridges across the Brahmani, the Badagenguti, the Mahanadi, the Birupa and the Nuna Rivers are in progress. The work is expected to be completed by the end of June 1965 in all respects.

The Orissa Construction Corporation, a Government of Orissa undertaking in the public sector, has undertaken a good number of major bridge and road works in the Expressway and other engineering projects. It is hoped that its activities will provide ample scope and encouragement to departmental execution of bridges hereafter.

The National Highway project which is financed from the loan assistance made available by the World Bank comprises the construction of 165 miles of road from Cuttack to Bihar border *via* Baripada, 17,335 running ft. of major bridges, 1,000 running ft. of minor bridges and 3,320 running ft. of culverts. The Birupa bridge is already completed and that over the Mahanadi is expected to be completed by the end of June 1964. Other major bridges are also in progress. Field and laboratory testing of soils is being taken up simultaneously to complete the very huge quantity of earth work involved in this project (nearly 16 crore c.ft.) with utmost expedition. The pavement thickness for the Highway is being designed on the basis of C.B.R. values so that, after completion, it can cater to the heavy traffic between Calcutta and Madras.

In spite of the immense wealth of natural resources, 'Orissa mirrors the paradox all backward areas, *viz.*, poverty amidst potential plenty,' as has been rightly observed by Dr. Khosla. The total water resources amount to 121 million acre-ft. ; and in terms of power potential, the resources are of the order of 8.44 million kW. Out of this, a microscopic fraction only has been utilized for irrigation and power generation.

For centuries, Orissa has been haunted by flood and drought, and of these, the latter has been the most terrible. Only two years ago in 1961, serious flood occurred damaging 650,000 acres of crop. Severe drought prevailed in most of the districts of Orissa in 1962 also and about 25% of the total cultivated area was affected, involving a loss of over Rs. 60 crores in *kharif* crop. To combat these, flood control and irrigation are the two basic needs of Orissa. To fulfil these needs, construction of the Tikerpara-Gania project and other river valley projects is essential, to provide complete flood control in the delta areas and to irrigate new lands, besides generating the essential power for development of industry.

Fortunately, at the right moment, a master plan for the integrated development of the river basins of Orissa which reveals promise for the future, has been drawn up by Dr. Khosla. Preliminary arrangements are being made with regard to the construction of the Tikerpara dam. The Tikerpara power project will cost about Rs. 175 crores and will have an installed capacity of 20 lakh kW of electricity, which will bring in a net return of nearly Rs. 40 crores a year. This yearly net return will transform the economy of Orissa into a self-generating one, enabling the balance of the master plan to be largely executed with the resources generated from the Tikerpara power project. Besides this, 6 million kW of power can be generated and 7 million acres of land irrigated with the remaining water resources of the State.

Orissa has remained industrially backward in the absence of adequate electric power. Even though a start was made during the First and Second Five Year Plans for the supply of much needed power for industry from the Hirakud and Machkund hydro-electric projects, a long way has yet to go before the optimum utilization of the natural resources is satisfactorily achieved.

It is also an admitted fact that inadequate transport and communication facilities have been a major barrier to the economic and industrial growth of Orissa.

Orissa has played a great part in the construction of the Hirakud dam and the Machkund hydro-electric and the Rourkela steel projects. At present, large projects like

Balimela, Paradeep port, the Expressway, Salandi and delta irrigation schemes, the National Highway, and Talcher thermal station are under construction. Other development projects, *viz.*, Tikerpara-Gania, Indravati, Upper Kolab and Bhimkund will soon be taken in hand. In the implementation of these vital projects, the State has to face problems of research and design. Scientific research and engineering research must proceed side by side so as to avoid time lag. In the circumstances, it is imperative that Orissa must have her own research and designs organizations. We are indeed fortunate that Dr. Khosla is amongst us. We shall be rightly looking forward for his guidance for the establishment of a full-fledged engineering research laboratory and a designs organizations in our State as early as possible.

I need hardly repeat here that the Institution is the premier professional body in the country covering its activities in all branches of engineering. I hope that all the engineers who are duly qualified but have not yet been members will enrol themselves as members of the Institution, thus to help the nation-building work in a coordinated and united way.'

Punjab Centre

Chairman's address by Shri S. Tara Singh, M.I.E., at the 19th Annual General Meeting of the Centre on December 29, 1963

After welcoming the Chief Guest, Sardar Partap Singh Kairon, Chief Minister of Punjab, and other invitees, Shri Tara Singh thanked the Committee of the Centre for electing him Chairman for 1963-64. He added that the Institution has a vital role to play as an all-India organization in the professional and economic fields of development of the country.

Delivering the Chairman's address, he said, 'Technical education being may own field, I will first deal with reference to the State of technical education in Punjab. The intake of students at the degree level in the State has been increased from 480 in 1960-61 to 840 in 1963-64 by expanding the three engineering colleges in the State and opening a Regional Engineering College at Kurukshetra, and the Thapar Institute of Engineering and Technology at Patiala, with an intake of 60 students in each. The intake is likely to increase further to 970 when the intake at the Regional Engineering College reaches 250 per year. New courses in metallurgy electrical communication and aeronautical engineering have been started at the Punjab Engineering College, Chandigarh, with an intake of 30 students in each. Post-graduate courses in irrigation and hydraulics and electrical power engineering have been added during the year 1963-64 at Chandigarh. Post-graduate courses in (i) rotodynamics and (ii) structural engineering are expected to be started in July 1964. An engineering tutorial institute has been started at the Guru Nanak Engineering College, Ludhiana, with effect from July 1963, to prepare diploma holders and Students for Sections A and B of the Associate Membership examinations of the Institution. A condensed course for the

B.Sc. (Engineering) degree is expected to be started at the Thapar Institute with effect from July 1964 for diploma-holders.

At the diploma level, the intake has been increased from 1,480 in 1960-61 to 2,200 in 1963-64 by opening four new polytechnics at Jhajjar, Sirsa, Guru Tegh Bahadur Garh and Hamirpur, and expanding some of the existing institutes. The intake will increase from 2,200 to 3,060 before the end of this Plan as the State Government is keen on having at least one polytechnic in each district. Post-diploma courses in automobile engineering are expected to start at the Government Polytechnic, Ambala, and the Guru Nanak Engineering College, Ludhiana, during 1964-65, with an annual intake of 30 students in each. A diploma course in architectural assistantship was started in 1963 with an annual intake of 30 students in the College of Architecture at Chandigarh. There is a proposal to start a 4-year sandwich diploma course at Faridabad with German assistance. Four-year part-time diploma courses in civil engineering, mechanical engineering and electrical engineering have been planned at the Central Polytechnic, Chandigarh; the Guru Nanak Engineering College, Ludhiana; and the Thapar Institute of Engineering and Technology, Patiala. All the expenditure involved is expected to be met by the Central Government.

The most important problem in technical education is not that of quantity or quality, but that of reducing wastage resulting from failures. According to the Planning Commission, the overall wastage in the engineering colleges and polytechnics is 25% and 50% respectively. This large wastage is due to the following reasons :

(i) Some students, although admitted on merit based on marks obtained in the qualifying examinations, do not have an aptitude for engineering;

(ii) There is a great shortage of teachers (40 to 60%) of different categories. Many teachers have little experience in teaching and practice;

(iii) Teachers go on shifting from one college to another and to the P.W.D. and the industries;

(iv) Some of the students leave the institution soon after joining, either because they cannot follow the subjects or because of financial difficulties;

(v) The grant and payment of interest-free loans takes a very long time, as much as 8 to 10 months, to materialise;

(vi) The amount of loan granted is much less than the average normal expenses of a student;

(vii) The question papers are set and moderated by external examiners only. In some cases, these papers are not set to fit the standards and this results in a large number of failures and consequent frustration among students;

(viii) Suitable text-books are not available for many subjects. The available books on engineering are very costly, and the majority of students, being poor, cannot afford to purchase them. They only rely on the class notes given by teachers. Since study of these notes is not supplemented by a regular study of suitable text-books, the students' performance in the examinations is not at all good;

(ix) The medium of instruction and examination is English, of which diploma students, who are mostly matriculates, have very poor knowledge. It is difficult for them to follow lectures in English and text-books written in English. They find themselves, therefore, unable to answer the question papers satisfactorily and thus fail in large numbers.

There is acute shortage of qualified teachers in polytechnics as engineering teaching is not financially attractive at present. It is, therefore, necessary to revise the salary scales of teachers. Further, there should be two grades for each category of staff, *i.e.*, Instructors, and Lecturers and Heads of Departments. The number of posts in the lower grade should be 70% and that in the higher grade 30%.

Since the standard of English taught in the schools is very low, to facilitate understanding of the engineering subjects and their basic concepts, the use of regional languages becomes a necessity. All technical terms may, however, be retained in English. English may also be taught to the diploma students during the course in order to enable them to study and understand engineering books written in English.

There is a worldwide trend to improve the quality of engineering education by incorporating in it more of science and humanities. On account of the spectacular advances in science, it has become necessary to further increase the contents of the basic science subjects such as physics, chemistry and mathematics in the degree courses. To achieve this objective, the contents of some subjects will have to be reduced, or, some of the subjects will have to be made elective as the students are already overloaded. At present, in the civil engineering degree course, the study of irrigation engineering, public health engineering, highway engineering and airports, railways, harbours and docks, hydrology, dams and water power engineering, industrial management and engineering, economics, architecture and town planning, etc. is compulsory. Therefore, consideration is necessary to see whether the subjects of irrigation engineering, public health engineering, highway engineering and airports, railways, harbours and docks, and architecture and town planning can be made elective. A candidate may take at least two subjects out of these five elective subjects.

Technical education has been made free in polytechnics with effect from August 1962. Poor and needy students are awarded interest-free loans and a sum of Rs. 14.35 lakhs was paid as loan to 2,400 degree and diploma students last year. It is necessary to increase the amount of loan in order to meet the higher costs of living, and the facility of loan must be provided to a great number of students. The steep rises in the number of technical institutions, intake of students, number of courses, and the quantum of loan and freeship facilities all show clearly that there has been remarkable development in Punjab in the field of technical education during the last two years. This development must continue vigorously in order to catch up with other States in this matter.

As far as the achievements of the engineering departments in the State are concerned, the Third Five Year Plan (1961-66) for roads stands approved for an outlay of Rs. 12 crores. During 1961-62, the actual expenditure on the construction of new roads was Rs. 2.70 crores, and a length of 350 miles was built in the State. In 1962-63, a sum of Rs. 2.50 crores was orginally allotted but due to the national emergency, the allocation was reduced to Rs. 1.50 crores which enabled the construction of 234 miles only. The total metalled mileage in the State at the end of 1962-63 stood at 6,980 miles, giving an incidence of 14.8 miles per 100 sq. miles of area and 0.34 mile per thousand persons. Comparatively greater attention was paid during this year to the construction of roads in hilly areas. Two major bridges, benefiting mainly the hilly areas, were completed during this year. Among the important construction works undertaken during the year under review may be mentioned the Medical College and Hospital at Rohtak, and expansion of some buildings at Amritsar and Patiala; the polytechnics at Hoshiarpur, Batala, Jajjhar, Hamirpur and Guru Teg Bahadur Garh; the new industrial training institutes at various places; the diary buildings at Verka, Ludhiana and Jullundur; and residences for officers and staff at some selected stations.

The Chandigarh Capital project is heading towards completion with the addition of the following structures during the year 1963; (i) Medical Institute, (ii) Town Hall (iii) 30 bays of office, (iv) Cable Factory, (v) Panchayat Bhawan, (vi) Grid Substation, (vii) Ball Bhawan, and (viii) Legislature buildings.

The other works in progress include an industrial training institute and hostels; a fire station; the Punjab Roadways Depot; a design and research centre; a polytechnic for women; and extensions to the engineering college.

The sewerage treatment plant is nearing completion and 31,700 running ft. of pipe has been laid. Many water supply works such as overhead reservoirs, underground reservoirs, etc. have been completed or are in progress. Work on rising mains for tube wells and water supply to sewerage treatment works is in progress.

The activities of the Punjab Public Health Department embrace the execution and the maintenance of (i) National Water Supply and Sanitation schemes: deposit works, on behalf of Local Bodies, Improvment Trusts and *Panchayats*; and (ii) water supply and drainage in connection with the development of *mandis*, industrial estates, development of colonies, and public buildings.

Since the introduction of the National Water Supply and Sanitation Programme, self-sufficiency has been attained in water supply in 60 towns, and in sewerage in 38 towns. Water supply schemes in 512 villages have been put into operation. A special water supply rural investigation division has been set up for carrying out surveys and collecting data for rural water supply schemes in areas where there is water scarcity.

The area irrigated by major and minor canals has increased from 72.7 to 75 lakh acres this year. The total cost of the Rajasthan Canal project to be constructed in the Punjab area is Rs. 24 crores. The project was started in 1958 and is scheduled to be completed next year. Many drainage and anti-waterlogging measures are also in progress. The Bhakra dam has been completed. The work on the Bhakra right bank power house is in full swing. All the civil works for the power house are likely to be completed by the end of 1964 and the first generating unit installed and commissioned by the end of 1965.

The preliminary works of the Beas project are nearing completion. The work of excavation, setting up of workshops, stores and other ancillary buildings is in hand. The Beas-Sutlej Link project envisages diversion of a part of the Beas into the Sutlej through a combination of tunnels and an open channel. The preliminary works on this project are in progress. About 17,500 ft. of drilling has already been done. Construction of bridges at Slapper and Ghamber and widening of the road at the Mandi-Pandoh section are in progress.

The Hydel Organization of the State is engaged with the task of carrying out investigations, planning and execution of various hydro-electric schemes. In spite of unfavourable climate and weather conditions, considerable progress was achieved on the Uhl hydro-electric project which envisages the installation of three sets of 15 MW capacity each, with provision for a fourth for future development.

The Upper Bari Doab Canal project involves the installation of three units of 15 MW capacity in the first stage, with provision for the addition of a second unit of the same capacity after the construction of Thein dam. About 40% of the works connected with this scheme are expected to be completed by the end of the Third Plan.

Besides these, complete project reports were submitted for the Thein dam multipurpose project and the Western Jamuna Canal hydro-electric scheme. Proposals are being formulated for harnessing the main hillstreams and utilizing these for the supply of electricity to remote and isolated areas.

The Punjab State Electricity Board will by the end of this financial year commission 10 diesel sets, each of 1 MW at Faridabad, Jullundur, Chandigarh, Pathankot, Amritsar, Ambala, Ludhiana and Ferozepore. Apart from this, preliminary work for the installation of a 15 MW thermal plant at Faridabad is also in progress. The power house at Belling Nullah in Lahaul Valley was commissioned in August 1963, and supply to upper and lower Kelong given. Nearly 53,000 new connections have been given by the Board this year. Also, 112 new villages have been electrified. The work of rural electrification has received a setback due to the paucity of funds. Preliminary work for the transmission system to be laid from the right bank power plant is expected to be completed during this year. Similarly, the 132 kV Bhiwani-Dadri line and two substations are scheduled to be commissioned this year. To meet the increasing public demand, the capacities of the various grid substations have been augmented and work on additional substations is in progress'.

The Punjab Centre of the Institution has planned for the construction of a building at Chandigarh. The total cost of the building is estimated to be about Rs. 3,00,000. The construction programme is planned in two phases. The construction of the building was taken in hand early this year. The annexe and the structure of the main building and the roofing have been completed.' In this task, help must come forth from various agencies. The Centre has full faith that with the kind help of the Chief Minister the Punjab Government will grant us sufficient funds to complete the building.'

Uttar Pradesh Centre

Chairman's address by Shri K. N. Misra, M.I.E., at the 43rd Annual General Meeting of the Centre on December 31, 1963

After welcoming the Chief Guest, Dr. K. L. Rao, M.I.E., Union Minister for Irrigation and Power, Government of India, and other invitees, Shri Misra thanked the Committee of the Centre for electing him Chairman for 1963-64.

Delivering the Chairman's Address, he said, 'Dr. Rao's contribution to the cause of engineering and to the progress of the Institution is too well known to need elaboration. Every engineer is justly proud of the fact that Dr. Rao's abilities as an engineer and his distinguished service to the country found recognition first on his being elected as Member of Parliament and subsequently on his appointment as Minister number of engineers eligible to become Corporate Members of the Institution is over 2,000, and it is regrettable that there are only 761 Corporate Members. It is, therefore, incumbent on every member, keeping in view the progress of the Institution and of the engineering profession, to make effort to increase the membership of the Institution.

In my address last year, I had suggested that, in order to help the Students of the *Institution* to get proper training, we should organise a number of coaching classes. I have much pleasure in announcing that one such class has already been started at Lucknow and is becoming increasingly popular. We are trying to organise such classes in Allahabad, Roorkee and other important places also and I hope that during the course of the next year, there will be many more coaching classes.

I like to suggest to the Students of the Institution thet they must organise and start more Students' Chapters so that by means of regular technical discussions amongst themselves they can improve their knowledge and appreciate the current trends in engineering.

The President of our Institution is keen that we should hold seminars on different technical topics to stimulate healthy discussion amongst engineers. Such discussions will be very beneficial indeed. It will be my endeavour during the coming year to arrange for holding a seminar at Lucknow to discuss such engineering subjects as may be determined by the new Committee of the Centre.

For a long time, I have the uneasy feeling that members of the technical services are not getting their due share in the administrative machinery of the Central and State

South Zonal Grid—Its Technical and Financial Implications

S. A. Quader
Member

In this paper, the utmost desirability of having a grid, particularly in the southern States to start with, is indicated. The idea can then be extended to other regions on an all-India basis. It is a well recognized fact that interconnection between area systems is the only means of reducing to the minimum the standby spare capacity, which results in considerable saving of capital expenditure. It also provides for the most satisfactory service to the consumers. In Europe, countries like France, Germany, Holland, Italy and Switzerland have interconnected their zonal systems. England is considering interconnection with the European grid through a submarine cable laid in the English Channel. In this paper, an attempt is made to justify the establishment of a grid for the power systems in south India. It also indicates the technical features and financial implications of such a project. The justification of having 380 kV transmission and establishment of super-thermal stations at Kothagudem and Ramagundam is also discussed.

Double-Stator Cage Induction Motor

L. M. Ray
Non-member
and
S. K. Jain
Non-member

The theory of a double-stator induction motor, having two stators with one relatively long cage rotor, is discussed. The torque-speed characteristic for (i) balanced supply on both the stators, and (ii) balanced on one and unbalanced on the other, has been deduced. It is shown that without much sacrifice of power factor and efficiency a gradual speed control in the operating range is available. It is also indicated that it is possible to hold the speed on light load anywhere between zero and the synchronous speed approximately.

A New Equivalence Technique in Linear Graph Theory

Prof. S. Srinivasan
Associate Member
and
V. N. Sujeer
Associate Member

This paper deals with the principles and the theory of a new technique of solving a given electric network by reducing it stage by stage using a new concept of equivalence.

This procedure permits calculations to be effected with matrices reduced in size to tractable level for use with a hand calculator or a digital computer. An example is worked out to illustrate the essential principles involved in the technique.

Linear Analysis of Systems

N. K. Suryanarayanan
Non-member

The analysis of a power system is carried out to obtain its performance characteristics under various conditions of operation and also to determine the design criteria of the system components. Various methods are available for power system analysis. However, the broad-based discipline method provides not only an alternative, but makes it possible to investigate the areas of the problem of system analysis which cannot be easily tackled otherwise. In this paper, the outline of a few systems are given and their mathematical models are established with the help of the broad-based discipline method using the linear graph theory.

HINDI SECTION

Low Cost Houses

G. C. Mathur
Non-member

and

R. K. Agarwal
Non-member

The guiding principles in the design of low cost houses in hot regions are given in this paper. The paper deals with size of plots and layout, economical use of land by construction of multistoreyed buildings in large cities and double-storeyed houses in towns. It provides guidance regarding orientation of buildings and houses and discusses the factors that promote thermal comfort in hot-arid and hot-humid regions. Suggestions are made with regard to architectural and space standards and the minimum accommodation to be provided in a house. Design considerations regarding foundations in different types of soils are dealt with. Suitable specifications for mortars for foundation concrete and masonary in foundation and plinth are given. The importance of damp-proofing and termite-proofing and the recommended methods to achieve them are indicated. The methods of building the superstructure of houses are explained. Brick walls of 9 in. thickness for two-storeyed houses are recommended and the advantages of waterproof mud plaster, cavity walls and hollow block walls described. Specifications for mortars for masonary in the superstructure of unframed and framed buildings are also given. For economy, the minimum ceiling height of 9 ft. consistent with thermal comfort is recommended based on experimental study. The methods of roofing and the factors to be considered in its design and for making the roofs watertight are discussed. The optimum door and window areas for healthful living have been specified. A resume of the new techniques and materials adopted in the construction of houses built at the International Low Cost Housing Exhibition held in New Delhi in 1954 is given.

Problem of Dynamic Shear Stress in Metal cutting

C. B. Mishra
Graduate

The problem of dynamic shear stress in metal cutting is very complicated. The constancy of this quantity has been a point of considerable controversy. Even if its constancy is accepted, there is a good deal of dispute over the explanations offered. An analysis of this problem is presented in this paper. The mechanics of metal cutting is explained and the cases of shear strength (i) when it is constant, and (ii) when it is a function of normal stress, is studied. The derivation of the plasticity conditions are indicated for these two cases and they are compared with Merchant's experimental results. The effect of normal shear stress, shear strain, cutting speed, feed and temperature on dynamic shear stress are considered. The research results obtained by various investigators in this field are presented on the basis of available literature and the explanations offered by them are discussed. On the basis of the above analysis, it is concluded that the dynamic shear stress remains constant with respect to the normal compressive stress, but there is controversy with regard to the explanations offered. Generally, dynamic shear stress is not influenced by the strain rate and the feed, and the cutting temperature has little effect on this.

Tamping Machines for Packing Ballast Indian Railways

F. X. A. Nazareth
Non-member

On account of the increasing density of traffic, fast speed of trains, and heavy goods wagons on trunk routes, it is necessary to have good and strong railway tracks. The maintenance of railway track by packing using manual labour was all right in the past, but it is not practical at present. It has now become necessary to pack ballast on railway tracks by the use of tamping machines. The author received practical training in this technique in foreign countries, and in this paper, he has described the types of tamping machines now being used on the Indian Railways.

Studies on Bhakra Dam

R. L. Sharma

Non-member

In this paper, the author has traced the development of the Bhakra dam project starting from the formulation of the idea in 1908 by Lt.-Governor Sir Louis Dane to the preparation and sanction of the final project in 1945. The work was undertaken for execution in 1947 after partition of the Punjab. It was decided to execute the work by a departmental agency, and the services of Mr. Slocum, a renowned dam specialist from the U.S.A., were obtained on a ten-year contract basis, and some more specialists were engaged on his advice. The Bhakra Control Board was formed with the Governor of Punjab as Chairman and Shri A. N. Khosla as Vice-Chairman. Three directorates, *viz*,, Directorate of Bhakra Design, Directorate of Construction and Plant Design and Directorate of Inspection and control, were organized under the General Manager and Chief Engineer of the Bhakra project. The necessary workshops and stores were established at Bhakra and the construction of the dam was completed in October 1962 up to its full designed height. The experience gained by Indian engineers in the construction of the Bhakra dam will be great use in the construction of high dams in the country in future.

Raja Jwala Prasad

Vishwambhar Prasad

Associate Member

The life of Raja Jwala Prasad, an eminent engineer of India, is briefly described. He was the first Indian to hold the post of chief engineer. As President of the Institution in 1931-32, in Lucknow, he said that the engineering profession opens a magnificent avenue of service to the nation. It offers us an important and impressive role to play in the country, which no other profession can claim to do. He was proud that India had very good irrigation, building and railway engineers but felt that the country was backward in many important branches of engineering such as agriculture, aeronautics, mechanical, electrical, etc.

Beginning with some reflections on the inventive and creative genius exhibited by Raja Jwala Prasad in undoing a toy and preparing another after the pattern of the Tantalus' cup even before he had started learning the three R's, the author has described his many achievements and the honours bestowed on him, as well as the thick and thin he had to vade through due to his patriotic spirit in those days of alien rule. He was arrested for treason, but after release, he was reinstated in Government service in the Uttar Pradesh, where by virtue of his ability he rose to the top position superseding his seniors many of whom were Europeans.

The author has also made a mention of the unique services rendered by him in giving shape to the dreams of Madan Mohan Malaviya, whereby he rejuvenated Indian architecture in the host of buildings that are seen at the campus of the Banaras Hindu University. His simple living, his belief in Indian culture, and his staunch faith in active life have all been well established.

INSTITUTION NOTICES

Seminar on 'Technical Education and Its Development (1966-81)' proposed to be held during the 45th Annual Convention in February 1965

Arising out of a proposal made by Prof. N. S. Govinda Rao, M.I.E., Chairman, Civil Engineering Division Board, and Convenor, Engineering Education Committee, that the Institution should take steps to offer suggestions on the perspective plan of educational development for the next 15 years (1966-81), specially on matters pertaining to development of technical education, with a view to submitting them in the form of a report for the consideration of the Central Planning Group set up by the Ministry of Education, Government of India, which has indicated that the Group would welcome the Institution's suggestions, the Council of the Institution decided at their 435th Meeting held at Bangalore on 23rd May, 1964, to organize a seminar on engineering education under the auspices of the Engineering Education Committee and resolved that for holding the seminar a small committee be appointed with Prof. Govinda Rao as Convenor. The seminar will be conducted during the 45th Annual Convention of the Institution which is likely to be held in February 1965 in Uttar Pradesh, the exact venue for which will be announced in the *Bulletin*.

An appeal issued by Prof. Govinda Rao to members and suggestions on the probable subjects for discussion at the seminar and the break-up of the subjects are given below for information.

Members are requested to extend their cooperation in this venture by active participation and submission of papers to be presented at the seminar.

The seminar is being planned in six technical sessions and is expected to bring in many important views which may have a vital place in the educational planning that is being envisaged by the Central Planning Group.

Members desirous of presenting papers at the seminar are requested to submit two copies of abstract of their paper not exceeding 500 words (bringing out in essence the scope of the subject presented) not later than **15th November, 1964,** and two copies of the full text of the paper not later than **15th December, 1964.** One copy of the abstract and the paper should be sent directly to Prof. N. S. Govinda Rao, M.I.E., Professor of Hydraulics and Civil Engineering, Department of Power Engineering, Indian Institute of Science, Bangalore 12, and the second copies of the same should reach the Headquarters Office on or before the specified dates.

An appeal to members

'Dear member,

'You are aware that the Ministry of Education has set up a Central Planning Group to prepare a broad outline of a perspective plan of educational development during the next 15 years (1966-81), and against its background, to prepare programmes for inclusion in the Fourth Five Year Plan (1966-71). The Institution of Engineers (India), having on its roll over 40,000 Students getting trained as engineers and more than 11,000 Corporate Members comprising directors, chief executives, designers and planners in engineering concerns, directors, professors and other research workers in engineering institutions and laboratories, and others like administrators, industrial consultants and technical experts, etc. should be vitally interested in the development of technical education in the country.

It was decided by the Council of the Institution of Engineers (India) at their 435th Meeting held in Bangalore in May 1964 to hold a Seminar on 'Technical Education and Its Development During 1966-81' during the 45th Annual Convention of the Institution some time in February 1965. The seminar is proposed to be held for three days in six sessions.

The purpose of the seminar is to provide a forum for discussion on all the aspects of technical education and its development with a view to submitting the results of these discussions in a suitable form to the Central Planning Group. Dr. T. Sen, President of the Institution, is also a member of the Central Planning Group and as such, will assist the Planning Group to consider these along with other subjects for preparing a comprehensive perspective plan of educational development.

The list of main subjects for discussion and the break-up of the subjects are given below. These merely indicate the scope of the discussion and do not in any way commit the sponsors of the seminar to any views. The authors of papers may or may not make use of the items listed under the subjects. They are free to submit one or more papers covering any or all the subjects put up for discussion. They can, if they desire, include new subjects or items for discussion in their papers. They are quite free to write papers in any manner they like and there is no restriction on the length of the papers to be submitted.

Authors are requested to send two copies of the abstract of their papers in advance of the papers, as said in the above notice. Of these, one copy of the abstract may be sent to the Secretary, Institution of Engineers (India), 8 Gokhale Road, Calcutta 20, and the other copy of the abstract to Prof. N. S. Govinda Rao, Indian Institute of Science, Bangalore 12. The same procedure may be followed for the papers also. Those who cannot spare time for writing papers may send a statement of their views on the several points detailed in the subject list, as also new points, if any.

The last date for receiving the manuscripts of papers is 30th November, 1964.

I now request every member to contribute papers covering all aspects of technical education so as to truly reflect the overall representative character of our Institution.

Thank you.'

(*Sd.*) **Prof. N. S. Govinda Rao**
Chairman, Civil Engineering Division Board, and
Convenor, Engineering Education Committee

SUBJECTS SUGGESTED AND THEIR BREAK-UP

1. Purpose and aims of technical education

(a) To train the mind to a rational way of thinking on any given problem.

(b) To teach the art of planning in the use of natural resources for economic development, *e.g.*, use of wind to develop power in villages, use of wood for industrial purposes instead of burning them as fuel, etc.

(c) To develop power of observation in understanding how nature works, how machines work, and how men behave.

(d) To develop manual skill in fabricating products.

(e) To develop qualities of discipline to subordinate one's own inclinations and behaviour to promote the general wellbeing of the country; to mould character, to develop qualities of leadership, initiative, capacity to obey, etc.

2. Levels at which technical education has to be imparted

(*a*) *Giving technical bias to general education*

At primary and secondary schools.

(*b*) *Training of skilled craftsmen*

- (a) Full time courses at pre-secondary (age group 12-16 years) and post-secondary stages (age group 16-19 years).
- (b) Sandwiched courses for industrial workers.
- (c) Part-time courses (evening courses, pre-secondary and post-secondary courses).

(*c*) *Training of overseers and foremen*

- (i) General courses (diploma courses such as L.M.E., L.E.E., etc.).
- (ii) Job-oriented courses (post-secondary, 3-5 years duration), *e.g.*, for foremen in foundry technology, machine tool design and manufacture; pumps, their design and manufacture; design and operation of printing machines; radio engineering, etc.
- (iii) Sandwiched courses and part-time courses for industrial employees.

(*d*) *Training of operatives and construction engineers* (*5 years after P.U.C.*)

- (i) General courses such as leading to B. E. in civil, mechanical, electrical, etc. branches.
- (ii) Job-oriented courses: evening courses (2 years duration after B.E.) (sandwiched with industry) in public health engineering, structural engineering, hydraulics and hydraulic machines, electrical machine design, thermal power engineering, etc.

Note—**The suggested main subjects for discussion are given in bold headings and the sub-titles and the break-up of the subjects in italic and ordinary types.**

(iii) Sandwiched courses and evening courses in general engineering for diploma holders and science graduates employed in engineering industries; A.M.I.E. courses of 3 years duration.

(e) *Training of designers, planners and management executives (2 years duration)*

(i) M. E. courses for designers, planners and industrial research and development workers (general courses) (2 years duration for B.E.'s and 5 years duration for M.Sc.'s).

(ii) M.Sc. engineering courses preparatory to Ph.D. (1 year of advanced science and 2 years of engineering).

(iii) Ph.D. course (1 year after M.Sc. and 2 years after M.E., based on research thesis, general and oral examination).

3. Coordination between technical education and general education and science education

1. Steps necessary to develop an integrated personality in technical men to enable them to play their part as useful citizens and lead a cultured disciplined life.

(a) Evening classes at skilled craftsman level (trade apprentices and workers); and evening classes for training artisans for S.S.L.C. examination.

(b) Evening classes for those who have passed S.S.L.C. to appear for the Studentship Examination of the Institution of Engineers (India).

(c) Evening classes for diploma holders (such as L.M.E., L.E.E., L.C.E., etc.) to appear for B.A. or B.Sc. degree examination.

2. Changes necessary in the curricula of studies at all levels (primary, secondary, and college levels) to hold an even balance between general education, science education, technical education, physical culture and N.C.C. training.

Number of hours per week to be devoted to each of these branches at the various levels of education and the list of subjects to be taught at various levels.

3. Holding short-term courses in subjects of general education and science ranging from 6-12 weeks in institutes to be started specially for this purpose and/or in existing institutions.

4. Holding seminars (short-time schools of study) in particular subjects.

4. Technical education and its impact on economic and social wellbeing of the society

(a) Correlation between increase in output of technical personnel and the standard of living.

(b) Technical education and its policy of management at ministerial and administrative levels by technical men.

(c) Type of technical education necessary for promoting and managing industrial concerns of all sizes.

(d) Technical education and its impact on general standards of morality, integrity and behaviour of technical personnel; Does the present type of technical education produce persons who value production of wealth above all other considerations of morality, integrity and other qualities necessary for social wellbeing?

5. Media for imparting technical education at all levels

(a) Relative importance to be given in teaching through the medium of the mother-tongue, Hindi and English at the craftsman's level, the diploma (L.M.E., etc.) level, the B.E. level and the post-graduate teaching and research levels.

(b) Merits and demerits of teaching using the media of instruction as suggested above.

(c) The place for study of a modern foreign language such as Russian, German, French, Japanese, etc. in technical education.

(d) Relative merits of having common English technical expressions in all our languages as against using expressions of common usage in different languages.

(e) Methods necessary for promoting study of Hindi by technical personnel; Is it necessary to replace English by Hindi as the common medium of expression?

6. Maintaining standards in technical education and revision of curricula and opening of new courses

(i) To keep in step with the developments in science and industry in general; and (ii) with the increase in our resources in technical teaching personnel, in indigenous manufacture of equipment, and in our capacity to finance technical education.

(a) *Method of maintaining standards at the craftsman, diploma and B.E. levels*

- (i) Periodical deputation of teaching staff to institutes specially set up for the purpose of giving short-term training.
- (ii) Periodical deputation of teaching staff to industries in India and abroad.
- (iii) Periodical deputation of teaching staff to fairs and exhibitions where equipment are exhibited.

(b) *Revision of curricula and opening new courses*

- (i) Appointment of a Standing Committee for each State and at the Centre consisting of representatives of teachers, directorates of technical education, industry, representatives from the Institution of Engineers (India), for planning technical education at the craftsman and diploma levels.

(ii) Entrusting the Institution of Engineers (India), which has on its roll teaching staff from technical institutions both in private and public sectors, technical consultants, directors at managerial level, executives at all levels in industry, owners of industries of all sizes, and experts in planning and administration of projects for developing technical education, with the work of maintaining standards, periodically reviewing curricula of existing courses and suggesting new courses (among the 11,000 Corporate Members, there are many experts interested in practically every aspect of technical education).

(iii) Relative merits of entrusing the work of maintaining standards, revision of curricula and opening new courses to government-sponsored organizations and the Institution of Engineers (India).

7. Methods of imparting knowledge of the latest developments and techniques in science and technology to those in employment

(a) *At the craftsman level*

(i) By the exhibition of films in factories, workshops and craftsman training institutes, with explanation in regional languages.

(ii) By the preparation of technical brochures with illustrations and photographs in regional languages.

(b) *At the diploma level*

(i) By audio-visual educational methods.

(ii) By the publication of technical journals in regional languages.

(iii) By holding short-term courses and seminars.

(iv) By encouraging diploma holders to join the Institution of Engineers (India) as Students and holding group discussions and seminars; and by giving them facilities to attend lectures and read journals of the Institution.

(c) *At the B.E. level*

(i) By audio-visual educational methods, short-term courses, seminars, etc.

(ii) By encouraging engineering graduates to join the Institution of Engineers (India) as Graduates or Corporate Members; by subsidising the finances involved in the purchase of technical books, and payment of subscriptions; and by giving facilities for attending meetings of the Institution of Engineers (India) to low salary income groups and to authors of papers accepted for discussion at regional and all-India conferences.

(d) *At the post-graduate level*

By the same methods as at the B.E. level; and by financing with the help of the Central Government delegates to international technical conferences whose papers have been accepted for discussion or who have been asked to preside at technical sessions of conferences.

By encouraging authors to write advanced text-books for post-graduate classes or treatises on select subjects.

By encouraging authors to translate treatises on select subjects in non-English languages to English.

8. Evaluation of the experience gained in the first three Five Year Plans

(a) Evaluation of the extent to which the objects mentioned under the subject entitled 'Purpose and aims of technical education' have been fulfilled.

(b) Evaluation of the experience gained regarding :

- (i) Procurement of staff.
- (ii) Procurement of equipment from indigenous sources and from abroad; and difficulties of foreign exchange.
- (iii) Planning and construction of buildings including land acquisition for buildings and sports.
- (iv) Procuring grants in time from the Central and State Governments.
- (v) Enforcing maintenance of standards.

Evaluation of efforts at the craftsman level

- (i) Ensuring minimum general education and ability to sketch and read drawings necessary for craftsman training.
- (ii) Ensuring proper training of instructors.

Evaluation of efforts at the diploma level

- (iii) Ensuring minimum knowledge of English for understanding lectures and text-books.
- (iv) Controlling the rate of expansion of polytechnics.

Evaluation of efforts at the B.E. level

- (vi) Controlling the rate of expansion of colleges and maintaining standards.
- (vii) Starting courses in newer branches of engineering.

General

- (xi) Encouraging production of technical literature and translation work.
- (x) Promoting engineering research through professional institutions like the Institution of Engineers (India), universities, National Laboratories, Defence Science and other organisations.

9. Determination of the long-term objectives of technical educational development in India and the form and extent of the technical educational system to be evolved in the country by 1980-81

(a) Number of technical personnel at various levels to be trained and the ratios; and the number of technical personnel at the level has to bear with the others.

(b) Number of technical institutes of various levels and their geographical and/or industrywise distribution in the country.

(c) Suggested alterations in the present form of imparting technical education at all levels ; Is it necessary to lay greater emphasis on imparting technical skill by practical work at some or all levels of technical education? Is it desirable to encourage sandwiched type of technical education where a part of a year (or any specified period of time) is spent in a factory and another part (or another specified period of time) is spent in teaching institutions? Is it desirable to encourage evening courses where workers are employed in factories and acquire theoretical knowledge only in the evenings in teaching institutions?

(d) Is it necessary to lay greater emphasis on teaching science objects at all levels of technical education? Is it desirable to conduct advanced courses in science only to those desiring to conduct research work?

10. Preparation of a phased programme for realizing the long-term objectives as under subject (9) and in particular, to determine the major programmes to be included in the Fourth Five Year Plan

(a) Suggestion of a phased programme emphasising the priorities to be given at all levels of technical education.

(b) Suggestions for the programme, regionwise and industrywise.

11. Special programmes to be evolved for the solution of urgent problems such as development of technical and vocational education and development of research [*vide* subject 2 entitled 'Levels at which technical education has to be imparted'].

(a) *Short-term measures for development of technical and vocational education*

(i) Training of skilled craftsman: opening more industrial training institutes ; giving intensive technical courses in selected special fields; opening new courses such as for training for brick and stone masons, concrete makers including reinforced and prestressed concrete, etc.; job-oriented courses in carpentry, *viz.*, formwork for concrete structures; and training for making foundry patterns, electrical fittings, etc. and machinists to operate special types of machines used in general workshops, automobile workshops, textile mills, etc.

(ii) Extending apprenticeship and training schemes to take in a larger number of persons.

(iii) Opening new institutes to give intensive practical training from six months to a year to diploma holders and graduates in engineering, making such training compulsory before the award of a diploma or degree.

(b) *Short-term measures for development of engineering research*

(i) Opening institutes for promoting design and development work of machines and equipment used in industry; and encouraging research problems arising out of these to be tackled in these institutes.

(ii) Encouraging firms of consulting engineers to specialize in particular branches of engineering and ensuring that the Central Government freely consults them ; allowing basic problems arising out of these to be tackled by these firms, or, referring them to institutes mentioned in (i) above or university colleges or National Laboratories.

(iii) Allocating foreign exchange for purchase of components of equipments in order to build the equipments locally.

(iv) Starting institutes of type mentioned in (i) above, adjacent to but under separate administration, in all the places where Indian Institutes of Technology and Regional Engineering Colleges are situated.

(v) Liberalising delegations to attend international meetings and conferences; and entrusting selection of delegates to institutions like the Institution of Engineers (India) which are free from Governmental and political influences.

(vi) Opening an institution devoted to development work of fabricating aids (such as working models, charts, films, etc.) to teach technical subjects at all levels.

12. Measures for the promotion of students' welfare, improvement of teachers and strengthening of technical institutions

(a) *Promotion of students' welfare*

These should provide

(i) Facilities to poor students for borrowing text-books for an academic year.

(ii) Facilities for reading in libraries from 8 a.m. to 10 p.m.

(iii) Facilities for consulting teachers when they have difficulties in solving problems or doing assignments.

(iv) Construction of more hostels and arrangement of conveyance to go to the institutions from city areas where public facilities are not satisfactory.

(v) Arrangement for purchase of text-books at subsidised prices.

(vi) Facilities for sports and playing fields.

(vii) Facilities for forming clubs and groups for discussion on technical and non-technical subjects, and for extra curricular activities like photography, music, drama, etc.

(b) *Promotion of teachers' welfare*

These should provide

(i) Better facilities for improving knowledge by encouraging teachers to join technical societies like the Institution of Engineers (India), and financing the expenditure involved in the payment of subscriptions involved and also for purchase of technical books.

(ii) Facilities by granting leave on full pay to teachers to better their academic qualifications.

(iii) Facilities to hold and attend seminars, summer schools for studies on selected subjects, and to work in industrial establishments to gain first-hand knowledge.

(iv) Facilities by granting leave to work in consulting engineers' offices, industrial establishments, National Laboratories and other institutions for periods of a year or more at a stretch.

(v) Facilities to staff working in colleges and institutions to go abroad for a year or more at a time to work in institutions outside India, to go as delegates to international conferences and seminars, and to observe techniques used in laboratories outside the country, etc.

(vi) Facilities to teachers to bring out text-books by granting them leave.

(vii) Better insurance, sickness gratuity and other benefits.

(viii) Quarters for teachers.

(c) *Strengthening of technical institutions*

This should be done by

Providing better teacher-student ratios in the institutions.

13. Improvement of curricula, teaching methods, text-books, teaching aids and reading materials

As covered under other subjects.

14. Measures to be adopted (a) for qualitative improvement in all sectors of technical education, and (b) for training the leadership essential for planned development

(a) Measures as covered under other subjects.

(b) Measures for training for leadership essential for planned development.

15. Estimating the finances required for the proposed programmes

16. Determination of priorities in view of the limitations of the available resources in men and money

17. Central-State and State-Local Body relationships including the problems of grant-in-aid.

18. Creating a permanent statistical agency to collect data with regard to technical manpower requirements of all categories and statistical evaluation of all aspects of technical education

(i) Collection of data with regard to technical manpower requirements at all levels, regionwise and industrywise.

(ii) Collection of data with regard to technical manpower requirements at all levels to start new industries or develop existing ones, according to the programmes of the Planning Commission.

(iii) Collection of data with regard to productivity and technical education at the craftsman's level.

(iv) Collection of data with regard to economic growth and growth of science-based industries employing high level technical personnel such as the chemical, electricity, electronics, petroleum, automobile, machine tool and heavy electrical machinery industries.

(v) Collection of data with regard to technical personnel and growth of industries manufacturing new products and new devices for automation of technical processes.

(vi) Collection of data with regard to technical personnel and growth of export and reduction of import of machines and spares.

19. Creating a research bureau to study all aspects of technical education and regulate deputation for foreign training of technical personnel

To undertake research pertaining items and subjects 1 to 18 described above.

Draft Indian Standards

The following draft Indian Standards have been issued recently.

Draft Indian Standard Code of Practice for Design of Overhead Travelling Cranes and Gantry Cranes other than Steel Work Cranes—Part 2 (Mechanical, Electrical, Inspection and Testing)—Doc : SMBDC 7 (542).

This part of the Code covers mechanical, electrical, inspection and testing requirements relating to the design, manufacture and erection of overhead travelling cranes and gantry cranes.

Members may send their comments on the above Code before October 20, 1964, to Shri D. C. Sharma (*M.*), 4E Sector 9C, Chandigarh, who is the Institution representative on the Sectional Committee dealing with this Code and a copy to Prof. N. S. Govinda Rao (*M.*), Chairman, Civil Engineering Division, Professor of Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12.

Draft Indian Standard Code of Practice for Application of Line Plaster Finish—Doc : BDC 8 (716).

The scope of the standard covers line finish to walls, ceilings, columns and similar surfaces on backgrounds suitable for receiving line plaster finish.

Members may send their comments on this draft Code to Shri T. R. Mehandru (*M.*), 14 Asaf Ali Road, Ajmeri Gate Extension, New Delhi, who is the Institution representative on the Sectional Committee dealing with this Code, and a copy to Prof. N. S. Govinda Rao (*M.*), at the above address.

Copies of the draft Standards may be obtained from the office of the Indian Standards Institution, 'Manak Bhavan', 9 Bahadur Shah Zafar Marg, New Delhi 1, or from its branch offices at 232 Dr. Dadabhoy Naoroji Road, Bombay 1; 11 Sooterkin Street, 3rd Floor, Calcutta 13; 14/69 Civil Lines, Kanpur; or 1/12 First Line Beach, Madras 1.

INSTITUTION NEWS

Donations by members to Headquarters Building Fund

Following the appeal issued to members in the *Bulletins* dated March, April and May 1964, for donations to the Headquarters Building Fund, given below is a list of members who have contributed to the Fund as on 25th August, 1964.

These donations are gratefully received, and in each case individual letters of thanks have been sent by the Secretary.

Member	Donation
Shri Seethamraju Srinivasa Appa Rao (*Student*)	Rs. 35.00
Shri Brijmohan Lal (*Member*)	Rs. 100.00
Major Ramesh Chander Beotra (*Associate Member*)	Rs. 25.00
Shri J. Sankaran (*Student*)	Rs. 20.00
Shri Ratindra Kumar Bhanti (*Student*)	Rs. 10.00
Shri Padam Sen Jain (*Student*)	Rs. 25.00
Shri Veer Shetty (*Student*)	Rs. 10.00
Shri Onkar Singh (*Student*)	Rs. 10.00
Shri Khitish Chandra Das (*Member*)	Rs. 30.00

The total donation received up to the above date is Rs. 265.00

Current Papers—a new publication of the Institution of Electrical Engineers

The Institution of Electrical Engineers, London, has announced the publication of a new monthly titled *Current Papers* from August 1964. This publication will consist of a list of about 700 titles (with authors and references) covering the fields of electrical and electronic engineering selected from several of the current and more important British and foreign periodicals. Foreign titles will be translated into English and an indication will be given of the language in which the original is written.

The new publication has been designed as a service to electrical and electronics engineers and supplements the service provided at present by *Science Abstracts* by offering a speedy reference to current publications.

FORTHCOMING CONFERENCES

Symposium on 'Evaluation of Rural Latrine Design', Nagpur, October 28, 1964

Further to the notice published on p. 40 of the *Bulletin* for April 1964, it is now understood that the above symposium will be held at the Central Public Health Engineering Research Institute, Nagpur, on October 28, 1964.

At this Symposium, a panel of experts will discuss different aspects of rural latrine designs on the following lines.

1. The pan
    - (i) Geometry and construction
    - (ii) Factors affecting minimum water requirements for proper flushing
    - (iii) New methods of construction with indigenous materials
2. The pit
    - (i) Design factors affecting the pit size, etc., depending on the various soil conditions
    - (ii) Construction features of the pit in special soils to prevent collapse, etc.
    - (iii) Absorption coefficient of various pit shapes in various soil conditions
    - (iv) Effect of absorption coefficient on the moisture content of pit contents and rate of digestion
3. Superstructure and other constructional features of latrines
4. Economics of the several aspects of the rural latrine
5. Social factors in the acceptance of latrines, extension techniques, requirements for popularising, problems to be faced, and appraisal of a method for this programme
6. Implications of the rural latrine programme on the health of villagers and its effects on public health
7. Use of pit contents as fertilizer
8. Pollution aspects of the night-soil affecting rural water supply in areas covered with pit latrine
9. Methods for making night-soil odourless.

First National Book Exhibition, New Delhi, November 1964

The National Book Trust, of India, is organising a National Book Exhibition on an all-India basis at the Exhibition Galleries of Rabindra Bhavan, New Delhi, in the last week of November 1964. This exhibition is being held in cooperation with the various publishers and booksellers' associations in India and with the assistance of Unesco and the Ministry of Education, Government of India. It is expected that nearly

15,000 books produced in India in all the languages and covering various subjects in arts and architecture, technology, the sciences, medicine, etc. will be on the show. The Trust also proposes to hold a convention of publishers and booksellers during the exhibition week.

Further information can be obtained from the Secretary, National Book Trust, (India), 23 Nizamuddin East, New Delhi 13.

Trade Fair at Utrecht, Holland, October 20-24, 1964

The Royal Netherlands Industries Fair Utrecht, the VOM (Society for Meta Finishing Techniques) and the Federation of Netherlands Decorating Employers will organize a new specialized trade fair at Utrecht, Holland, from October 20 to 24, 1964. The fair will present a complete picture of techniques in the metal finishing field such as electrodeposition, chemical treatments, hot-dip galvanizing, metal spraying, organic and inorganic coatings, anodizing and electroplating, metal colouring, vitreous enamelling, shot blasting, and further equipment and processes for the finishing of industrial products. It will give a broad survey of the applications for the products of the paint and varnish industry in the building, maintenance and metalworking branches; and painters' and decorators' requisites such as spray guns, compressors and lacquering machines. There will also be information stands where the foreign visitor can satisfy himself concerning the overall technical problems and export facilities, and Dutch methods of vocational education and training. Accompanying the fair will be a show of prize pieces of work of an international painting contest.

IFAC Symposium on 'Automatic Control in the Peaceful Uses of Space', Norway, June 21-24, 1965

A Symposium on 'Automatic Control in the Peaceful Uses of Space', organized by the Norwegian National Committee of the International Federation of Automatic Control (IFAC), will be held in Stavanger, Norway, from June 21 to 24, 1965. The following topics are suggested for presentation of papers.

(1) Injection into Space
    (i) Control of launching vehicles for stability of operation
    (ii) Guidance of vehicles for correct trajectory
(2) Attitude Stabilization
    (i) Passive methods of satellite and exploratory vehicle stabilization
    (ii) Methods based on expenditure of fuel
    (iii) Methods based on gyroscopic phenomena
    (iv) Methods based on magnetic phenomena
(3) Remote Control of Space Vehicles
    (i) Correction of orbits at great distances
    (ii) Remote control of planetary landings

- (iii) Re-entry control techniques

(4) Problems of Manned Systems

- (i) Characteristics of man as part of a vehicle control loop
- (ii) Optimum use of man in control of space vehicles, in orbit and during re-entry

(5) Ground Systems

- (i) Automatic launching systems
- (ii) Systems for control of ground antennas
- (iii) Closed loop systems with control from the ground

(6) Advanced Components for Space Vehicle and Instrumentation Control Problems

- (i) Inertial, stellar and terrestrial navigation sensors
- (ii) Power control elements
- (iii) Signal processing components
- (iv) Signal conditioning telemetry
- (v) Optical components

(7) Digital and Analogue Computers as Used in Automatic Control Systems in Space Vehicles or Ground Stations

- (i) Computer system
- (ii) Computer components
- (iii) Programming of computers

(8) Future Control Problems

- (i) Systems for remote exploration of planets
- (ii) Requirements for control components for space vehicle control

Members wishing to contribute papers on the above topics are requested to note the following schedule of dates carefully—deadline for submission of abstracts of papers to the Headquarters of the Institution at Calcutta is November 1, 1964; and deadline for submission of complete papers is February 1, 1965.

Further details can be obtained from the Technical Officer (Scientific) at the Institution.

IFAC Tokyo Symposium on 'Systems Engineering for Control System Design', Tokyo, August 25-28, 1965

At the Executive Council Meeting of the International Federation of Automatic Control (IFAC) held at Basle, Switzerland, in September 1963, it was agreed that an international symposium on the subject of 'Systems Engineering for Control System Design' should be held in Tokyo—sponsored by the IFAC Technical Committees on Theory and on Applications. Accordingly, the IFAC Tokyo Symposium Committee has been organized under the auspices of the Science Council of Japan and the symposium will be held in Tokyo from August 25-28, 1964.

The symposium will be arranged as a series of round-table type discussions, where nearly 20 papers may be read to initiate effective discussion.

The following items are expected to be dealt with at the symposium, though the sessions will be finally classified in accordance with the papers accepted:

1. Identification of systems characteristics
    - Description of organization of system
    - Identification of static and dynamic characteristics
    - Modelling and simulation of systems
    - System objectives and/or evaluation
2. Algorithms of complicated control systems
    - Multi-level control systems
    - Optimization and adaptation
    - Learning systems
    - Multi-variable control systems
3. Realization of large systems
    - Large industrial production process
    - Utility, transportation and communication systems

As simultaneous translation will not be available at the symposium, it is desirable that speakers read their papers in English. If papers are presented in languages other than English, the summary should be translated into English. At the discussions, it is hoped that participants versed in languages will assist in overcoming any translation difficulties that may occur. Submission of papers should be made not later than 1st November, 1964, by sending two copies of abstract to the Symposium Committee. The abstract should be approximately 600 to 900 words, typewritten in double-spacing.

Further details can be obtained from the IFAC Tokyo Symposium Committee, Tokyo Central P.O. Box 1057, Tokyo, Japan.

Third IFAC Congress on Automatic Control, London, June 20-26, 1966

The Third Congress of the International Federation of Automatic Control (IFAC) will be held in London from June 20 to 26, 1966, on the invitation of the United Kingdom Automation Council (UKAC). The two previous Congresses were held in Moscow (1960) and in Basle (1963).

Papers dealing with topics on components or applications or the theory of automatic control should be submitted to the Institution of Engineers (India), which is the IFAC Member-Organization for India, before the close of March 1965. It is preferred that theory papers should bridge the gap between theory and practice. Papers on biological problems will also be admitted. The adopted papers will be printed before the Congress meets in order to allow the participants in the Congress to prepare for discussions.

Further details will be printed in this column of the *Bulletin* as and when announced by the IFAC Headquarters.

BOOK ACKNOWLEDGMENTS

1. **The Analysis of Braced Domes.** B. S. Benjamin. *Asia Publishing House,* Rs. 12. 110 pages.

In this book, a detailed analysis of three important types of dome, *viz*, the Schwedler dome, the stiff-jointed dome and the ribbed dome, is given. Starting from the fundamentals, the author presents both analytical and graphical methods for the analysis of these important structures. Worked-out examples explain the application of the theory to practical analysis. A separate chapter deals with an original method of analysis based on the shell analogy developed by the author. This book will be of use to the advanced student of structural engineering as well as the designer and the architect.

2. **Hydraulics.** N. V. Nayak. *New Asian Publishers,* Delhi. 1962, Rs. 7.75. 172 pages.

Written to meet the requirements of the final year diploma and the second year degree students, the book deals with the fundamental principles of hydraulics and their application. A set of questions and examples are given at the end of each chapter. The Metric and the British systems of unit are used in this book.

3. **Strength of Materials.** J. C. Mehta. *New Asian Publishers,* Delhi. 1964, Rs. 10.50. 478 pages.

This book is intended for students preparing for a university degree in engineering or architecture, and the Section A of the Associate Membership Examination of the Institution of Engineers (India). Each chapter gives typical worked-out examples followed by questions for practice.

4. **Construction Equipment.** Mahesh Varma. *Metropolitan Book Co. (P.) Ltd.,* Delhi. 1964, Rs. 17.50. 329 pages.

This book covers the design, application and maintenance aspects of construction equipment used in modern construction works. Illustrations of construction machinery at work are also included.

5. **Geology for Engineers.** Prof. G. B. Kanuga. *New Asian Publishers,* Delhi. 1964, Rs. 10. 364 pages.

Geology is an important subject in the field of engineering, as it deals with the composition, arrangement and origin of the rocks of the earth and the processes involved in the evolution of their present structures. A proper understanding of the subject is essential for the location of hydro-electric projects, dams, railways, highways, multi-storey building, etc. This book will be useful to civil engineers and others engaged in the construction industry.

6. **Elementary Surveying.** M. L. Nangru. *New Asian Publishers,* Delhi. 1963, Rs. 6.50. 192 pages.

This book is meant for students preparing for an examination in the 'Elementary Surveying' paper of technical institutions and the 'Civil Engineering' paper of State Technical Education Boards.

7. **Examples in Engineering Physics.** V. N. Wanchoo and R. C. Saxena. *New Asian Publishers,* Delhi. 1962, Rs. 4.75. 150 pages.

This book contains worked-out examples and exercises on the subject of 'Principles and Applications of Heat, Light and Sound'.

8. **Fundamentals of Process Engineering.** V. Kovan. *Foreign Languages Publishing House,* Moscow. 485 pages.

Mass production of machinery which raises the technical standards of national economy has been possible only due to the development of high production manufacturing methods. Technical progress is characterized by an inseparable bond between the designing of more perfect machinery and the development of more efficient processes for their manufacture. Characterizing process engineering as a science, its object being the study of the methods for manufacturing machines of a specified quality and at a rate prescribed by the required volume of production, with the minimum feasible amount of live and materialized labour, *i.e.*, at minimum cost, this book deals with the creative activity in the field of planning new, progressive manufacturing methods and making new designs of machines for whose manufacture the most highly efficient production methods may be employed.

9. **Digital Storage Systems.** W. Renwick. *E. & F. N. Spon Ltd.,* 1964, 50s. 212 pages.

Digital techniques are now finding widespread application in all branches of engineering and science. Almost all the applications require data storage. This book aims at filling this need for outlining principles by seeking to consider detailed circuits for particular systems. The areas of application of storage systems are described, the physical principles on which various systems are based are mentioned, the merits and the drawbacks of the systems available today are assessed, and the recent developments in research which may be of importance are surveyed. A bibliography for specialized reading has also been included.

10. **Fundamentals of Radio.** I. Zherebtsov. *Foreign Languages Publishing House,* Moscow. 537 pages.

This book explains the fundamentals of radio communication and deals with oscillatory circuits, aerials and propagation of radio waves, electron valves, rectifiers, electro-acoustic devices, low frequency amplifiers, valve oscillators and transmitters, radio receivers, radio measurements and semi-conductor devices in radio.

11. **Physical Metallurgy Principles.** R. E. Reed-Hill. *D. Van Nostrand Co., Inc.,* $ 10.95. 630 pages.

Complicated ideas are easier to understand and remember if they are not presented as isolated facts ; and this theoretical approach to physical metallurgy acknowledges that the properties of metals and alloys are determined by simple physical laws and it is not necessary to consider each alloy as a separate entity. While its approach is largely theoretical, this book covers all phases of metal behaviour normally found in physical metallurgy texts. The text is designed for an introductory course in physical metallurgy for engineering students and the pre-requisites are college physics, chemistry, and strength of materials ; an engineering course in thermodynamics is desirable but not essential.

12. **Examples in Engineering Science for General Course Students.** D. R. L. Smith. *Blackie and Son Ltd.,* 8s. 109 pages.

Intended to be an addition to lecture notes for students who enter the second year of the general engineering course and also for those who cover the course in one year, the book may be used for tutorials and homework. Each chapter is illustrated by worked-out examples with answers to problems.

PUBLICATIONS RECEIVED

Two copies of 'Publication No. 20—Annual Report 1963' have been received from the Department of Civil and Hydraulic Engineering, Indian Institute of Science, Bangalore 12. This report gives details of the research work carried out and in progress at the Hydraulics and Hydraulic Machines Laboratory, Structures and Concrete Laboratory, and Soil Mechanics Laboratory of the Department of Civil and Hydraulic Engineering of the Indian Institute of Science. Publication of research papers and discussion on them has formed a major part of the report. The report covers other technical activities such as assistance rendered to industry, Government departments and institutions, consulting work, development works done during the year, etc. and participation of staff in the work of other organizations.

A copy of the Forty-Fourth Annual Report (1962-63) of the Council of the Indian Institute of Science, Bangalore, has been received. This report deals with the activities of the Indian Institute of Science and the research work undertaken in its various departments and laboratories.

A copy of the fourth edition (1964-65) of the 'British Instruments Directory and Buyers' Guide has been received from the United Science Press, Ltd., 9 Gough Square, Fleet Street, London, E.C.4. This publication gives the names of associations allied to the instrument industry; specifications of official bodies; consultants, engineers and installers of instrumentation schemes; firms able to manufacture prototype or small batches of instruments to a client's order; classified list of scientific and industrial instruments and components; alphabetical list of instrument and component manufacturers, together with oversea agents and trade names; and glossaries of technical terms for apparatus, equipment, instruments, etc. in French, German, Spanish' Russian, Italian, etc. and their English translations.

A copy of 'British Petroleum Equipment 1963-64' has been received from the Council of British Manufacturers of Petroleum Equipment, 118 Southwark Street, London, S.E.1. This publication gives the work of the Council of British Manufacturers of Petroleum Equipment, the Officers and the Executive Committee, an index to classified list of British equipment and services, a classified list of British equipment and services, list of members, an index to members' catalogue announcements, and members' catalogue announcements. This Directory will be of great interest to buyers of a wide range of instruments and components of British make.

A copy of brochure entitled 'In Quest of Railway Safety' by D. C. Desai has been received from the Commissioner of Railway Safety, 707 Manoranjan Park, Meerut City. This publication deals with the principal railway safety problems and their solution by the introduction of new safety devices to prevent accidents due to failure of the human element. In this brochure, the author desires scientists and engineers to communicate their views and suggestions on new railway safety devices to him.

LIST OF NEW ELECTIONS AND TRANSFERS

(Continued from Bulletin for July 1964)

STUDENTS

No.	Name
46711	Eruch Gustadji Sabawalla
46712	Manohar Trimbakrao Hirde
46713	Ramesh Chander
46714	Vas Dev Chaudhari
46715	Duraisami Chandrasekaran
46716	Asis Kumar Chaudhuri
46717	V. K. Ramanathan
46718	Manik Chand
46719	Viswanatha Sankaran
46720	Suriendra Kumar Sarin
46721	Balasubramania Venkataraman
46722	Gomathinayagam Srinivasan
46723	V. Srinivasamurthy
46724	Dhirendra Prasad
46725	Harihara Sahu
46726	M. Natarajan
46727	Mahalingam Navasingh
46728	S. Durairaj
46729	Pothavajhyula Chiranjeevi
46730	A. Ebenezer
46731	Kanniah Kulasekharan
46732	Ramesh Chandra Mahanty
46733	Sonamuthu Subbiah
46734	Perangattu Koshy Cheriyan
46735	Raju Anantha Padmanaban
46736	P. N. Sadasivan
46737	S. Namasivayam
46738	Komali Krishna Prasad
46739	K. S Srivatsan
46740	Kothandaramaiyer Sankaran
46741	Roshan Lal
46742	Peringottukurussi Anantham Subramanian
46743	Vijay Kumar Jain
46744	Chinnakrishnanaidu Sampat
46745	Vanama Venkateswarlu
46746	Baidyanath Dutta
46747	Venkatachalam Rangarajan
46748	Prem Kishore
46749	Krishan Lal Malhotra
46750	Kandasami Kadarkarai
46751	Athipatty Venkataraman Ramasamy
46752	Darshan Lal
46753	Rais Ahmad Khan
46754	Vijay Kumar Adlakha
46755	Raminder Singh Nibber
46756	Sunil Kumar Maiti
46757	Avva Ramaiah Govinda Setty
46758	Sruthaprakash Vagvijayan
46759	Subbiahpillai Kulanthaivelu
46760	Conjeevaram Natesan Vedachalam
46761	Madhav Trimbak Zambare
46762	Kaliyur Narayanaswamyiyer Viswanath
46763	Komaragiri Murali Krishna Mohan
46764	Madhukar Narhar Pawar
46765	Udho Ram Arya
46766	Prasantakumar Bhattacharya
46767	Rabi Ranjan Das
46768	K. Raghavendra
46769	Geetindranarayan Datta
46770	Gowribidnur Narayana Swami
46771	M. Shivanna
46772	Bijoy Kumar Sur
46773	Mohammad Kamaluddin
46774	Ranjit Kumar De
46775	Ajit Kumar Ray
46776	Bangalore Venkatakrishnaiah Srinivasa Rao
46777	Eyunni Rajagopalan
46778	K. S. Desikan
46779	Adaikkam Lakshmanan Rengasamy
46780	S. V. Rajan
46781	M M. Sukumaran
46782	Mumukuta Venkata Subramania Sarma
46783	R. Damodara Kamath
46784	S. Selvaraj
66785	Venkataraman Ramaswamy
46786	Angadipuram Krishna Shivaswamy
46787	Prasanna Kumar Pradhan
46788	Oleti Ramaswamy
46789	Gian Chand Goel
46790	G. Narayan
46791	Belur Keshaviengar Ramanna
46792	Ami Chand Kothari
46793	Sachin Kumar Bondopadhaya
46794	Lakshmi Kanta Bhattacharya

STUDENTS—(*contd.*)

No.	Name
46795	Tapas Kumar Bhattacharyya
46796	Madhu Sudan Lal
46797	Rafique Ahmed
46798	Amitava Aich
46799	Kewal Krishan
46800	Thimmaiahgowda Srinivasaiah
46801	Gobinda Lal Mukherjee
46802	Debapriya Sinha
46803	Amarendra Nath Dutt
46804	Biswanath Chakrabarty
46805	Dharmadas Maitra
46806	Bimalendu De
46807	Chinmay Datta Choudhuri
46808	Niloy Krishna Mukhopadhya
46809	Kamlesh Kumar Singh
46810	Mohammed Abdul Gaffar Shariff
46811	Ranjit Singh
46812	Mallapla Channabasappa
46813	Kodibail Chandrashekhar Shetty
46814	Venkatachala Dandapani
46815	Chougule Padamanna Jambu
46816	Amar Singh
46817	Krishan Chand Batra
46818	Sitarama Krishnamurthy
46819	Dhuma Chandra Sahoo
46820	Bhavani Venkata Subbrahmanyam
46821	Erode Babu Deenadayalu
46822	Vijendra Kumar Mathur
46823	Dulal Chandra Bagchi
46824	Akam Venkata Satyanarayana Rao
46825	Chitoor Subbaraman Padmanabhan
46826	Dhirendra Kumar Biswal
46827	A. Kuppuswamy
46828	Chickbasappa Basavaraju
46829	Nonavinakere Sreenivasagopal Garudadwajan
46830	Bangalore Venkateshkumar Jayaraghavendra
46831	M. S. Nagendra
46832	Harogoppa Subbasastry Prabhakara Sastry
46833	Rangarao Suresh
46834	Mjr. Harnam Singh Chhachhi
46835	Rabindra Chandra Bhattacharyya
46836	Ratna Kant Jha
46837	Gunadhar Sain
46838	Pijushendu Gupta

No.	Name
46839	Hans Raj Uppal
46840	Kirtikumar Ratilal Shah
46841	Jandhyala Ramachandra Murty
46842	Mahesh Chandra
46843	R. Seshan
46844	Danasundaram Kalyanasundaram
46845	Sadashiv Annappa Patil
46846	Ramesh Kumar Gulati
46847	Avasara Venkata Krishna Rao
46848	Vinayak Mahadeo Apte
46849	Subramaniachetty Chandrasekaran
46850	Manickampillai Subramanian
46851	Niranjan Valecha
46852	Krishnan Unnikrishnan
46853	Pascal Baxla
46854	Ram Samar Gangopadhyay
46855	K. Gundu Shetty
46856	Sekharipuram Krishnan Ramanathan
46857	Jetho Hiranand Madnani
46858	Balasundaram Arunachalam
46859	Kalimuthu Ramamoorthy
46860	K. H. Nagaraja Rao
46861	Padam Chand Jain
46862	Bhabatosh Das
46863	Karaikudi Sankaranarayana Ganesan
46864	Muktheswaram Ramasubba Raju
46865	Suresh Chandra
46866	Devendra Pratap Singh
46867	Harish Chandra Sardana
46868	Harikrishna Prasad Mallela
46869	Shankar Gurling Tayshete
46870	B. S. Sathyanarayan
46871	Jog Bhushan Gupta
46872	Kalyanadurg Seshagirirao Venugopala Rao
46873	M. N. Krishna Murthy
46874	Banvati Srikantiah Krishna Swamy
46875	Dharamendraiah Nagaraj
46876	Mahableshwar Narayan Savant
46877	D. G. Sharanappa
46878	Nuggehalli Srinivasan Sridharan
46879	K. R. Srinivasa Babu
46880	G. N. Ananthu
46881	Karahatty Rangaswamiah Anantharaman
46882	K. Anantharaman
46883	Sudhansukumar Datta

STUDENTS—(*contd.*)

No.	Name
46884	Subrahmanyam Valmiki
46885	Pramnath Arjandass Vohra
46886	Chakravarthi Venkataraman
46887	Murugappachettiar Balakrishnamurthi
46888	Susarla Venkata Rama Sastri
46889	Gilman Paes
46890	Lakhan Singh
46891	Prem Parkash Narang
46892	Vasant Shreedhar Herlekar
46893	Sankaranarayanaiyer Balakrishnan
46894	Krishnadas Chanda
46895	Lendale Pandari
46896	Jai Ram Guru
46897	Vasanta Kumar Sharma
46898	Om Parkash
46899	Dilip Kumar Bose
46900	Mohammed Abdul Qwadeer
46901	Bihari Lal
46902	Kasoju Laxminarayan
46903	Ram Karan Gupta
46904	Jagdish Chander Handa
46905	Janardan Damodar Kharche
46906	Ramesh Chandra Khantwal
46907	Sathur Varadaraja Rangarajan
46908	Jawaharlal Gulabchand Modase
46909	Sankar Raha
46910	Shaikh Harunar Rashid
46911	Asok Kumar Ghosh
46912	Surendra Narayan Shanbhag
46913	Ponnur Ponnusami Bharadeswaran
46914	Nataraja Ramachandran
46915	Zubair Ahmed Khan
46916	D. M. Ravindra
46917	B. J. Padmarajaiah
46918	Karim Mohammed Yakub
46919	M. K. Mir Mohamed Ali
46920	G. S. Jagadeesha
46921	Devanagundhi Sheshadri Dwarkanath
46922	Siddappa Venkataravanaiah
46923	Srirama
46924	Subhash Chander
46925	Shankar Marotarao Barlewar
46926	Bastian Simon
46927	Krishnamurthy Rama Rao
46928	Battepati Govindarajulu
46929	Khader Mohiyuddin Bijli
46930	T. P. Vijaya
46931	Venkateshaiah Venkata Subba Rao
46932	Kalenahally Anniahsastry Suryanarayana
46933	Vairavelu Sudhakar Babu
46934	M. Sripada Rao
46935	Surendra Kumar Sachdeva
46936	Agaram Tandonirao Pandu Ranga Vittal
46937	T N. Venkataramaiah
46938	C. Sathyananda
46939	Kanaya Lakhandani
46940	Raman Subramanian
46941	Trivandrum Ramaseshan Balakrishnan
46942	Devi Chand Batta
46943	Ashok Kumar Sinha
46944	Pagadala Radhakrishna Reddi
46945	Gopal Dattatraya Kelkar
46946	Prabhakar Shankar Walhekar
46948	Pasula Rajesham
46949	Vishnu Govind Patki
46950	Vijaykumar Vasantrao Kshirsagar
46951	Muthiahchettiar Ramanathan
46952	Ramesh Kashinath Naik
46953	Raju Alex
46954	Prem Paul Sharma
46955	Maddipatla Chinna Mastanappa
46956	Vadakkenchery Maniiyer Venkiteswaran
46957	Saripilli Ravi Sankar Sarma
46958	Rayagouda Bandu Bele
46959	Badrilal Motilal Totale
46960	Dusanapudi Subba Rao
46961	Asghar Ali
46962	Siddaveeraiah
46963	Kompella Gopala Krishna Murthy
46964	Satyanarayan Tejmal Mundhada
46965	Jagdish Chander
46966	Surinder Nath Bajaj
46967	Lt.-Col. Om Dev Surie
46968	T. Vidyadhara
46969	Jagarapu Nageswara Rao
46970	Ranganatha Venkatraman
46971	Harish Chander Gupta
46972	Ram Kishore Gupta
46973	Kuldip Singh Nagpal
46974	Sureshchandra Bhagawan Satalkar

STUDENTS—(*contd.*)

No.	Name
46975	Gurmukh Singh Khalsa
46976	Sita Ram Makhija
46977	Ramaswamychakravarthy Doreswamy
46978	Kallubahvi Satyendra Deeksith Daniel
46979	Ganapathyagraharam Swaminatha Balachandran
46980	Cpl. Shaligram Ojha
46981	Chandrakant Balaji Katakkar
46982	Pralay Sankar Dhar
46983	Suhas Chandra Biswas
46984	Niloy Kumar Poddar
46985	Keserla Subbarayadu
46986	Kalkunte Rangaswamy Varada Rajan
46987	Bellur Shivaramiah Pranesh
46989	K. R. Balaji
46990	Karaikuruchi Sundararaja Gopalan
46991	Magadi Gopalaiah Venkatesha Murthy
46992	Lac. Mohan Singh
46993	Mysore Ramachandrarao Venugopala
46994	Srikantabhattaru Nanjundaswamy
46995	T. G. Ranganathan
46996	Jagdish Rai Puri
46997	B. H. Ramanna
46998	Madampatti Marudappa Subbiah
46999	Rachavachari Sarangapani
47000	Kiggal Sankaranarayana Udaya Shankar
47001	Adamane Venkatasubbiah Govinda Rao
47002	Kamireddy Satyanarayana
47003	Shivaram
47004	K. Venkataramaiah
47005	K. A. Srinivasan
47006	Raghunathan Ganesan
47007	Navuluru Venkata Ranga Rao
47008	Gande Sadanadam
47009	L. Sridhar
47010	Kamalakar Gangadharrao Saraf
47011	Navanath Rangnath Naiknavare
47012	Natarajan Lakshmanan
47013	K. Sivaramakrishan
47014	Nainappa Duraiswamy
47015	Krishnamurthy Loganathan
47016	Moolky Madhavaraya Bhat
47017	Virupaxayya Balayya Hiremath
47018	Shrikisan Badrinarayan Agrawal
47019	Kuppelli Subbaraya Nagaraja
47020	V. Basave Gowda
47021	Krishnaswamyiyengar Sampathu
47022	G. Abdul Khaseem
47023	R. Nagendra Karanth
47024	M. S. Venkatesh
47025	K. V. Krishna Murthy
47026	Malur Narayanaswamy Balaji
47027	Kotikanyadanam Sundaratat Rajagopal
47028	C. K. Narayana
47029	K. V. Seshachalapathi
47030	Lakshminarasimha Rama Prasad
47031	Hussan Lal
47032	Arvind Chintaman Gore
47033	Vinayak Gopal Phadke
47034	Harihar Trimbak Kulkarni
47035	Madhav Nagesh Ghate
47036	Subbarao Krishanaswamy
47037	Tripunithura Subramanian
47038	Alangudi Venkatarama Ramachandran
47039	Gopalakrishna Rajamanickam
47040	M. C. Subbarama Raju
47041	Narayana Krishnamoorthy
47042	Sanjeevamoorthy Gurunath
47043	Paranji Sri Gopalan
47044	Kanukolanu Venkata Harinatha Mohana Rao
47045	Kamalakar Narayan Ghalke
47046	Rabindranath De
47047	Prafullachandra Digambar Awate
47048	Mohan Vithal Rao
47049	Thomas Chinnappa
47050	Cheruvathoor Mathew Cheru
47051	Om Parkash
47052	T. Dharmaveera
47053	Sukhdev Lal Singh
47054	Sarvajna Veerabasappa Dhulappanavar
47055	Vishnu Narhar Joshi
47056	H. G. Nagarajan
47057	Venkitachalam Shankaranarayan
47058	Kuttapanicker Balasubrama Panicker
47059	K. R. Suryanarayana Murthy
47060	M. A. Varghese Kutty
47061	Panchumarty Ramachandra Rao
47062	Aiyappanpillai Aiyappan
47063	Varghese Eapen

STUDENTS—(*contd.*)

No.	Name
47064	Veerabhadrappa Gurushiddappa Uppin
47065	Chandra Kant Misra
47066	Govindaraja Kannan
47067	Mahesh Pal
47068	Chandrakant Tatyaji Nerle
47069	Prakash Sadashiv Kale
47070	Mungamur Srinivasa Rao
47071	Krishnarajanagara Narasappa Gopalakrishna
47072	Varikkara Gopalakrishnan
47073	Jitender Datta Sharma
47074	K. Mathew Zachariah
47075	G. Dharanindra Panicker
47076	Vallabhaneni Mallikharjuna Rao
47077	Shivaram Balisha Chougule
47078	Suresh Dattopant Landge
47079	Vidyadhar Anant Konkar
47080	Veloopillai Sankarankutty Nair
47081	Sadhu Singh Rikhiraj
47082	Suhas Dinkar Dongre
47083	Bijoyratan Sen
47084	Surinder Singh Chawla
47085	Piara Singh Jaswal
47086	Dharam Vir Singh
47087	Mukhtiar Singh Sidhu
47088	Satnam Singh
47089	Kulbhushan Kumar Sahni
47090	Krishan Lal Sethi
47091	Som Datt Sharma
47092	Ved Raj
47093	Major Singh
47094	Om Prakash Mehta
47095	Mohinder Singh Sandhu
47096	N. Krishnaswamy
47097	Amrit Lal Gupta
47098	Budh Singh
47099	Jit Singh
47100	Gurdip Singh Kang
47101	Mohinder Singh
47102	Krishan Baldev Duggal
47103	Ram Murti
47104	Vidya Rattan
47105	Teja Singh
47106	Khairati Lal Kapoor
47107	Ram Lal Kotwal
47108	Sudesh Kumar Vig
47109	Radhey Shyam Goel
47110	K. Chalapathi Rao
47111	Gopal Dass Banga
47112	Chandi Charan Sanyal
47113	Maddhi Pundarikaksha Rao
47114	Raj Kumar Singal
47115	Pratap Singh
47116	Moosa Ibrahim Kutty
47117	Subbaramiah Srinivasan
47118	S. Aswatha Narayana Rao
47119	Mardambail Narayana Shambhogue
47120	C. K. Asok
47121	Arvindbhai Jethabhai Patel
47122	Jayantilal Ramajibhai Parmar
47123	Mohinder Pal
47124	Pudukottai Sankaran Chandramouli
47125	Ravinder Kumar Arora
47126	Jai Pal Singh
47127	Karam Singh
47128	Krishan Singh Dogra
47129	S. Sridhar
47130	Abdula Mohammedulla
47131	Madan Lal Gupta
47132	Ibrahim Bandeali
47133	Yash Pal Sawhney
47134	Chandrakant Vallabhbhai Patel
47135	Devendra Prasad Mathur
47136	Jagmohan Singh
47137	Mohammed Zaheeruddin
47138	Veluru Parthasarathy
47139	Achintya Kumar Bhattacharya
47140	Sudesh Kumar Sharma
47141	Iqbal Singh Sandhu
47142	Manda Srinivasu
47143	Naremaddepalli Seshagirir Shankar Rao
47144	Saeedur Zafar Siddiquie
47145	Sunil Kumar Sarkar
47146	Samarendra Nath Paul
47147	Surjit Singh Dogra
47148	Subramanian Sankaran
47149	Raj Kumar Sharma
47150	Dhiman Chaudhuri
47151	Shivnarayan Janakiram Dahad
47152	Sitaram Murlidhar Kedar
47153	Mamprayil Mani Joseph

STUDENTS—(*contd.*)

No.	Name
47154	Shardhanand
47155	Lakshmi Chand Garg
47156	Santipriya Tarafdar
47157	Amitabha Datta
47158	Sudarsan Chaudhury
47159	Lakshmi Kanta Mukhopadhya
47160	John Satya Prasad
47161	Sisirkumar Haldar
47162	Ram Nath Arora
47163	Madhukar Rajaram Ratnaparkhi
47164	Annavadhula Nagaraja Sarma
47165	Mahesh Chandra Arora
47166	Omesh Chand Madan
47167	Baburao Pandurang Patil
47168	Nimai Charan Mahapatra
47169	Sundaramiyer Sesha Iyer
47170	Dev Raj
47171	Subodh Chandra Bera
47172	Narayanaiyer Lakshmana Iyer
47173	Madhusudan Halder
47174	Puthiyedath Govindan Kutty Nambiar
47175	Om Datt
47176	Bhubanendra Ballabh Pande
47177	Dharani Mohan Ghosh
47178	Salil Kumar Sen Gupta
47179	Ranjit Kumar Datta
47180	Ramesh Chandra Guryani
47181	Satishchandra Baburao Fulmali
47182	Atul Deb Sikder
47183	Mohan Mukhopadhyay
47184	Jaharlal Bandyopadhyay
47185	Ramesh Chand Mathur
47186	Haridas Kundu
47187	Chandrashekhar Ganesh Limaye
47188	Nirmal Kumar Biswas
47189	Om Prakash Agrawal
47190	Changdeo Shivaji Kamble
47191	Desh Deepak Goyal
47192	Moti Lal Kaul
47193	Ghanshyam Singh
47194	Amaresh Chattopadhyaya
47195	Gour Sankar Das Sarma
47196	Bhupesh Kumar Nayar
47197	Samar Abdul Mohamed Shereef
47198	Satish Chand Gupta
47199	Gangadhar Vishnu Bhate
47200	Chandrakant Keshavlal Sheth
47201	Lajpat Rai Bajaj
47202	Narinder Singh
47203	Madan Lal
47204	Brajesh Prasad Saksena
47205	Sharad Madhav Hasurkar
47206	Anant Keshav Abhyankar
47207	Muhammad Abdul Mughnikhan Yusufzai
47208	Yogesh Chand Jain
47209	Dhani Ram Choodhry
47210	Sarvesh Kumar Rastogi
47211	Jagdish Prasad Gupta
47212	P. Narasingh Bhan
47213	Nimai Chandra Kaiti
47214	Pranatosh Ghosh
47215	Sirasanagandla Viswanatha Sarma
47216	P. G. Suresh Babu
47217	Samarendra Nath Bagchi
47218	Jyotika Ranjan Bhattacharyya
47219	Subrata Gupta
47220	Chittaranjan Bhattacharyya
47221	Gokul Singh Chauhan
47222	Pradip Kumar Datta
47223	Deboprosad Mitra
47224	Chandradip Prasad
47225	Bhajan Singh
47226	Madan Mohan Nigam
47227	Singamsetty Naga Subba Ratnamaiah
47228	Sunilendu Sarkar
47229	Anil Behari
47230	Ram Lalchand Bhatia
47231	Vijaykumar Shankarrao Turekar
47232	Chandra Pal Singh Raghav
47233	Mahesh Chand Maheshwari
47234	Krishna Kant Roy
47235	Ramesh Chandra Sharma
47236	Paritosh Kumar Moulik
47237	Kacho Vasant
47238	Amirneni Venkata Basavaiah
47239	Moinuddin Mohiuddin Ankolkar
47240	Gurudev Singh Thakur
47241	Somnath Ghosh
47242	Santosh Kumar Bindal
47243	Satya Deo Sharma

STUDENTS—(*contd.*)

No.	Name	No.	Name
47244	Jitendra Mohan Mehta	47289	Alummoottil Samuel Abraham
47245	Ayalur Parameswaraiyer Krishnan	47290	Shrikrishna Gopinath Ambegaonkar
47246	Narayan Prasad Tiwari	47291	Sunil Kumar Panchanan Biswas
47247	Fariduddin Khan	47292	Lakshmi Narain Singh
47248	Rama Nand Sharma	47293	Arunachala Gopalan
47249	Ram Kishun Bhargava	47294	Subramaniya Kulathu
47250	Kishan Pal Singh	47295	Shiv Prasad Kapil
47251	Bindingnovley Yetirajiyengar Sathyanarayan	47296	Relangi Nageswara Rao
47252	Tikam Gopaldas Lallchandani	47297	Dilip Kumar Chattopadhyay
47253	Kambam Vardhaiyengar Balamukund	47298	Manab Das Gupta
47254	Shambhu Govind Bhat	47299	Rajiva Lochan Shrivastava
47255	Gopal Damodar Limaye	47300	Atulya Charan Bhaumik
47256	Sureshchandra Vallabhdas Shah	47301	Sudhansusekhar Nag
47257	Rajendra Kumar Sangal	47302	Tapan Kumar Bhattacharya
47258	Kanaiyalal Nanubhai Desai	47303	Ghanshyam Bharani
47259	Rameswamy Ranganathan	47304	Japendranath Chattopadhya
47260	Shankar Appaji Ravan	47305	Ashimkumar Mukhopadhyay
47261	Harish Chandra Johri	47306	Asok Kumar Bhattacharya
47262	Arangode Subramania Krishnan	47307	Amarendra Nath Mukhopadhya
47263	Mintubhushan Dutt	47308	Gour Hari Banerjee
47264	Balkrishna Chandulal Patel	47309	Utpal Ghosh Dastidar
47265	Shabihul Hasan	47310	Ananda Chattopadhyay
47266	Athmanatha Hariharan	47311	Aloke Kumar Guha
47267	Ahmedally Esmailbhai Shakir	47312	Jaswant Rai Logani
47268	Vasant Ravaji Khambe	47313	Saktiprasad Dey
47269	Erattupulickal Cherian John	47314	Murari Mohan Mitra
47270	Dina Nath Verma	47315	Anandamohan Sarkar
47271	Madho Ram	47316	Gobinda Das Kundu
47272	Lal Singh Jagdeo	47317	Sushil Chandra Roy Choudhury
47273	Navinchandra Narshibhai Pinara	47318	Arun Kumar Bandyopadhyay
47274	Dipak Kumar Basu	47319	Chandra Nath Tulal
47275	K. V. Balaramaiah	47320	Nirmal Kumar Bhowmik
47276	R. Seshagiri	47321	Abdul Gaffar Sirdar
47277	Shrinivas Krishnarao Kulkarni	47322	Pijush Kanti Guha Ray
47278	Prabhakar Laxman Nene	47323	Mrityunjoy Nag
47279	Narayan Sanjiv Hoblekar	47324	Subhadri Bhattacharya
47280	Kunal Chandra Mitra	47325	Guruprasad Adhya
47281	Ashok Mehta	47326	Jiban Krishna Chaudhuri
47282	Babulal Ranchhodbhai Rathod	47327	Amitabha Banerjee
47283	Jyotiranjan Bhattacharya	47328	Nitai Charan Goswami
47284	Manas Kanti Das	47329	Subhash Chandra Sarkar
47285	Asok Kumar Sen	47330	Barindra Kumar Ghosh
47286	Anil Kumar Sarkar	47331	Arun Kumar Ray
47287	Biswarup Kundu	47332	Amal Mohan Bhattacharyya
47288	Gobind Ram Chawla	47333	Bijoy Krishna Natta

STUDENTS—(*contd.*)

No.	Name
47334	Sunilkumar Bhattacharyya
47335	Dwijakumar Mukhopadhyay
47336	Chinmoy Choudhury
47337	Subrata Kumar De
47338	Radheshwar Thakur
47339	Chikkanayakanahally Venkataramaiah Shankara Sastry
47340	Tarak Nath Chakrabarty
47341	Indu Lal Dey
47342	Kalyan Mitra
47343	Bhaskar Sinha
47344	Dilip Sengupta
47345	Debes Chakrabarti
47346	Someswar Dasgupta
47348	Hirendra Sankar Roy
47349	Asit Kumar Bagchi
47350	Sridhar Sen
47351	Hillol Roy Choudhuri
47352	Nalini Ranjan Ghosh
47353	Tarun Kumar Ghosh
47354	Dipak Krishna Acharya
47355	Shyam Sundar Basak
47356	Bansibadan Saha
47357	Swapan Kumar Bandyopadhya
47358	Umapada Tripathi
47359	Shamalranjan Sengupta
47360	Kalachand Mukhopadhyay
47361	Gopal Chandra Das Dey
47362	Animesh Kumar Mitra
47363	Suprabhat Kumar Datta
47364	Sailendra Kumar Nandy
47365	Subhash Chandra Ray
47366	Benimadhab Naha
47367	Vinayak Purshottam Manjrekar
47368	Jitendra Nath Neogi
47369	Bankim Chandra Saha
47370	Timir Lal Mitra
47371	Samir Kumar Sen Gupta
47372	Sakshigopal Basu
47373	Dilip Kumar Dey
47374	Barun Baran Chakravarty
47375	Mahendra Hazaree
47376	Subhash Chander Bhatia
47377	Tarunchand Basu
47378	Priya Gopal Chattaraj
47379	Anand Prakash
47380	Ram Prakash Aneja
47381	Bidhu Bhushan Singh
47382	Chander Mohan Malhotra
47383	Kishori Mohan Ghosh
47384	Sunil Kumar Banerjee
47385	Dilip Kumar Datta
47386	Pijush Kumar Ghosh
47387	Nitya Lal Chak avortty
47388	Arun Kumar Kar
47389	Suresh Ramchandra Date
47390	Binay Kumar Sinha
47391	Chittaranjan Konar
47392	Gururaj Narasimha Mirji
47393	Ramesh Narayan Wanage
47394	Parameswaran Krishna Pillai
47395	Sumiti Kumar Basu
47396	Narendra Rangnathrao Selinkar
47397	Maniklal Chakraborty
47398	Birendra Nath Ghosh
47399	Arunabha Basu
47400	Asit Kumar Datta
47401	Sankar Debnath
47402	Subrata Ghosh
47403	Shyama Prosad Bit
47404	K. Santosh Kumar
47405	Kartik Chandra Bharadwaj
47406	Raghunath Basu
47407	Gangadhar Chattopadhyay
47408	Swapan Kumar Chattopadhya
47409	Subhas Chandra Chakraborty
47410	Pottayil Viswanath
47411	Bapu Vasudeorao Deshpande
47412	Sistla Ramakrishnaiah
47413	Mrinal Sinha
47414	Manoranjan Das
47415	Autar Krishen Koul Naz
47416	Gora Chand Mitra
47417	Ashim Kumar Dutta
47418	Jitendra Nath Bhattacharya
47419	Chiranjib Chandra Mukhopadhyay
47420	Tushar Kanti Biswas
47421	Gurudas Ray
47422	Kailash Nath Bhargava
47423	Chittur Anandapadmanaban Ramakrishnan

STUDENTS—(*contd.*)

No.	Name
47424	Sailendra Nath Sanyal
47425	Nirmalranjan Bandyopadhyay
47426	Debasish Datta
47427	Jagadis Chandra Mandal
47428	Pradip Bhattacharya
47429	Susanta Kumar Datta
47430	Mohanlal Chuharmal Ramrakhiani
47431	Dipak Chandra Chakraborty
47432	Prasanta Kumar Sarkar
47433	Sukhendu Sekhar Das
47434	Prasun Kumar Sarkar
47435	Digesh Chandra Guha
47436	Pratap Narain Thakur
47437	Chittaranjan Bhattacharyya
47438	Prabhjit Singh
47439	Prem Behari Saxena
47440	Hari-Om Agarwal
47441	Virendra Behari
47442	Anil Sadashiv Raje
47443	Partha Sarathi Sen
47444	Prem Kumar Agrawal
47445	Kulbir Chander Sharma
47446	Dharmakumar Prasankumar Mehta
47447	Ram Prasad Bhattacharyya
47448	Ram Nawal Shukla
47449	Pranab Kumar Datta
47450	Benoyendra Kumar Bhanja
47451	Santi Bhusan Saha
47452	Susil Kumar Kundu
47453	Susanta Kumar Gupta
47454	Sukanta Kumar Ray
47455	Babban Singh
47456	N. P. Sukumaran
47457	Manojbihari Chattaraj
47458	Amarendranath Das Adhikary
47459	Sadhan Kumar Mukhopadhyay
47460	Sakti Pada Bedajna
47461	E. S. Sivakumaran
47462	Jyotirmay Ray
47463	I. Ramesh Shetty
47464	Tripatikumar Raychaudhury
47465	Narayan Rajaram Bambulkar
47466	Rajendar Singh Ghai
47467	Ganta Yellamandayya
47468	Jankiti Nagaiah
47469	Chandrakant Jagannath Sawant
47470	Ravindra Vinayak Pradhan
47471	Durga Prasad
47472	Sohan Singh
47473	Pravinchandra Mohanlal Panchal
47474	Gopalakrishna Viswanathan
47475	Kulapaka Sathiraju
47476	Jagmohan Lal Dhawan
47477	Balkrishna Narayan Sawant
47478	Sesha Chary
47479	Harabadrai Somchand Patel
47480	Bhagwan Mohanbhai Kathrotia
47481	Narsingh Gulraj Dadlani
47482	Pradip Kumar Bhattacharjee
47483	Nandkumar Murlidhar Navasarikar
47484	Vishwanath Laxman Kunte
47485	Ambale Visvesvariah Ramanarasimhan
47486	Vidya Prakash Bajpai
47487	Gouranga Bhattacharya
47488	Jasbir Singh Virk
47489	Baldev Raj Kumar
47490	Sushil Kumar Bansal
47491	Ajit Kumar Gangopadhyay
47492	Chandrakant Motichand Shah
47493	Sadashiv Chintaman Raste
47494	Beli Ram Sharma
47495	Gian Chand
47496	Kunjithapatham Kalyanam
47497	Arvind Shankarrao Katdare
47498	Ravindra Kant Kakkar
47499	Yengala Narasinha Rao
47500	M. Sampath
47501	Pissey Sham Ramachandra Rao
47502	Sarmukh Singh
47503	Joginder Singh
47504	Kommineni Venkata Raja Rao
47505	Biswanath Chakravarty
47506	Rai Shailendra Pratap Singh Baronia
47507	Bhalchandra Mallappa Khanna
47508	Uppalapati Umamaheswara Rao
47509	Rajmal Zazaria
47510	Hari Shankar Dubey
47511	Charanjit Singh Chaman
47512	Rangavajhala Srirama Sastri

STUDENTS—*(contd.)*

No.	Name	No.	Name
47513	Kochupuracal Mathew Sebastian	47558	Anil Kumar Ahluwalia
47514	Man Mohan Mathur	47559	V. K. Sahadevan
47515	Ravinuthala Srinivasarao	47560	V. V. John
47516	Gyaneshwar Kumar Gaur	47561	Seethamraju Chandrasekara Sarma
47517	Ambati Appa Rao	47562	Ram Niwas Singh Gautam
47518	Harvinder Singh Anand	47563	Sumer Chand Jain
47519	Biraj Bandhu Bandyopadhyay	47564	Raj Singh
47520	Nanak Kumar Valeja	47565	Goparana China Chidambaram
47521	Gurcharan Singh Taggar	47566	Malladi Balakrishna Murty
47522	Ranganathan Venkatraman	47567	Gurbachan Lal Dhawan
47523	Minoo Dinshawji Sumariwalla	47568	Krovvidi Ramakrishna Parama Hamsa
47524	Prashant Kumar Mishra	47569	Sarvesh Chandra Saxena
47525	Shyam Mohan Sinha	47570	Pheru Mal
47526	Jajam Nageswara Rao	47571	Ashok Janiram Vazirani
47527	Jitendra Bahadur Singh	47572	A. Sitaraman
47528	Pampati Balaji	47573	Jagdish Prasad Khare
47529	Ajit Kumar Sen Gupta	47574	Radha Krishna Audichya
47530	Arunaditya Mukhopadhyaya	47575	Hari Om Mittal
47531	Kashmiri Lal	47576	Sudama Ram
47532	Vasant Sitaram Tahmankar	47577	Ram Pravesh Prasad
47533	Vinod Kumar Kapoor	47578	Chinmoy Kumar Misra
47534	Somendra Prasad Saxena	47579	Rasik Mohan Asthana
47535	K. Skaria	47580	Anant Ganesh Apte
47536	P. Balan	47581	Vasuddeo Lal Sahu
47537	Amal Mohan Basu	47582	Rudra Dutta Sharma
47538	Gajendra Prasad	47583	Siddheswar De
47539	Dhannalal Pannalal More	47584	Venkatesh Balacharya Warkhedi
47540	Vedula Venkatarayudu	47585	Jayanti Shankar Sharma
47541	Om Prakash Gupta	47586	Mazhuvammannil Mathai Raju
47542	Kommaraju Ramamohana Rao	47587	Kul Bandhoo Sharma
47543	Kuldip Singh Virdi	47588	Vemparala Venkata Narayana Murty
47544	Mahboob Jani	47589	Mahesh Chandra Srivastava
47545	Sankar Chakravarti	47590	Jagannath Mandal
47546	Satwant Singh Sadhar	47591	K. Madhavan
47547	Tushar Kanti De	47592	Vijay Kumar Soodhi
47548	Naresh Chand Gupta	47593	Vemagiri Paul Devadatham
47549	Jivram Nanjibhai Joshi	47594	Varanat Chandran Menon
47550	Madhubhai Punjabhai Patel	47595	Dwarka Prasad Gupta
47551	Jarnail Singh Sidhu	47596	K. Rajagopalan
47552	Akhil Chandra Naha Roy	47597	Subes Chandra Guha Majumdar
47553	Tarun Kumar Das	47598	Borreddi Chandra Sekhara Reddy
47554	Asok Mukhopadhyay	47599	Babu Karkal Shamsundar
47555	Valangaman Ramamurti Krishna	47600	Ramesh Nathaji More
47556	Shesh Kumar Dhurandhar	47601	Gaganan Shankar Kulkarni
47557	Srikant Narayanarao Agashe	47602	Gadiraju Subbaraju

STUDENTS—*(contd.)*

No.	Name
47603	U. Namdeva Shenoy
47604	Bhimsen Dhawan
47605	Samarendra Nath Roy Chaudhury
47606	Hem Raj Darwesh
47607	Asuri Veera Bhashyacharlu
47608	Burra Hanumantha Rao
47609	Lingareddy Chandrasekhar Reddy
47610	Satya Narayan Singh
47611	Guntur Subba Rao
47612	Suresh Kumar Nayar
47613	Allu Narasimha Rao
47614	Prem Pal Singh
47615	Abdul Waheed
47616	Pran Nath Mahrotra
47617	Sushil Kumar Devidin Pal
47618	Vatish Chandra Arora
47619	Mohinder Singh Ratra
47620	Krishna Gopal Sharma
47621	Anand Prakash
47622	Braj Mohan Singh
47623	Deonandan Prasad
47624	Beeram Nageshwar Rao
47625	Nanunair Bhaskaran Pillai
47626	Baboo Khan
47627	M. L. Divakar
47628	S. Subramonia Iyer
47629	Surya Bhanu Singh Gautam
47630	Ainavolu Rama Rao
47631	Harish Chander Tulsiani
47632	Joginder Pal Aggarwal
47633	Govind Prasad Bichpuria
47634	Kehar Singh Sahu
47635	Dev Bandhu Sharma
47636	Murkoth Padingarail Vijayaratnam
47637	Gyan Prakash Sharma
47638	Ganesh Chandra Ghatak
47639	Raghubir Prasad
47640	Pinakpani Bhattacharya
47641	Ambaty Anjaneyulu
47642	Devi Singh Kushwaha
47643	Faqir Chand Ahluwalia
47644	Kailash Chandra Nigam
47645	Manthina Satyanarayana
47646	Nawnath Tiwari
47647	Vijay Kumar Dwivedi
47648	Tolety Venkata Satya Surya Prakash
47649	Prasanta Banerjee
47650	Ganesh Chandra Ghosh
47651	Kali Charan
47652	Banshi Ram
47653	Sachindra Nath Halder
47654	Kameshwar Prasad Shrivastava
47655	Gulab Singh
47656	Roopchand Nathulal Patida
47657	Narinder Kumar Singal
47658	Banwari Lal Gupta
47659	Daljit Singh Sachdeo
47660	Dineshchandra Ugarchand Rathod
47661	Yad Ram
47662	Bibekananda Bandyopadhyay
47663	Akshaya Kumar Mandal
47664	Ishwar Singh
47665	Sheo Prasad Rajput
47666	Pranab Kumar Das Gupta
47667	Irinjalakuda Sangameswara Vivekanandan
47668	Debashish Chatterjee
47669	Lalit Mohan Sharma
47670	Shyama Kanta Das
47671	Vijai Prakasha Kulsheresttha
47672	Prakash Chandra Sharma
47673	Chinta Haran Lal Shrivastava
47674	Mukund Dinkar Gupte
47675	Ram Bharos
47676	Jagdish Prasad
47677	Gangadhara Rao
47678	Ram Bhagwan Roy
47679	Arun Mathur
47680	Lakshmanaiyer Vidhianathan
47681	Yelamanchili Sri Krishnamurthy
47682	Ramprasad Konar
47683	Lachhmandas Hemandas Jadwani
47684	Nishtala Srirama Sarma
47685	Jagdish Prasad Sharma
47686	Hira Lal Kochhar
47687	Banavar Venkataramarao Gopal
47688	Kuldip Chand Puri
47689	Suresh Chandra
47690	Virendra Lal
47691	Vinod Kumar
47692	Himansubikas Ghosh

STUDENTS—(*contd.*)

No.	Name
47693	Boddu Subba Rao
47694	Sheo Shankar Lal Srivastava
47695	Papanaidugari Prabhakara Rao
47696	Dhan Prakash Goel
47697	Tej Bahadur Lal
47698	Bolanthuruguthu Sunder Rai
47699	Divi Venkataramanaiah
47700	Brij Mohan
47701	Yogendra Mohan
47702	Goda Venkata Gopala Krishna Rao
47703	P. C. Cheriyan
47704	Suresh Chandra Chaturvedi
47705	Satchidananda Ray
47706	Ranjitkumar Das
47707	Surendra Pal Sharma
47708	Subhash Nakra
47709	Ghanshyam Dutt Viyas
47710	Ramesh Bahadur Saxena
47711	Badri Nath Verma
47712	Ganapathyiyer Krishnamurthy Iyer
47713	Raja Babu Mathur
47714	Upkar Singh
47715	Giridhar Hanumantrao Kawde
47716	Balaraja Satyanarayana Murty
47717	Thati Jagannadham
47718	Chitta Ranjan Bora
47719	Vinod Kumar Rohatgi
47720	Girraj Singh Maliya
47721	Ram Dass
47722	Ved Prakash Jain
47723	Panda Venkata Satyanarayana
47724	Vemuri Subba Rao
47725	Khaja Rafiq Ahmed Ansari
47726	Dhara Subrahmanya Sastry
47727	Syed Mohammed Ashraf
47728	Digumarthy Surya Bhaskara Rao
47729	Sista Kameswara Rao
47730	Krishnaswamyiyengar Lakshmiraghavan
47731	Prasanta Kumar Das
47732	S. Shanmugha Sundaram
47733	Bipinchandra Mojilal Gandhi
47734	Satya Pal Sharma
47735	Makara Dhwaj Agrawal
47736	Peesapati Parvateesam
47737	Narayan Pralhad Moharir
47738	Inderjit
47739	Ram Niwas Gupta
47740	Rajeshwar Prasad Sharma
47741	Mahesh Kumar Khanna
47742	Jai Ram
47743	Debranjan Sengupta
47744	Buddhiprasad Chimanlal Kansara
47745	K. M. Madhavan Namboodiri
47746	Gourpada Roy Sarkar
47747	Rajeshwari Pandey
47748	Suresh Chandra Srivastava
47749	Sujit Kumar Pal
47750	Shailendra Kumar Sachan
47751	Radha Krishna Ram
47752	P. V. Madhavan
47753	Santu Arjandas Motwani
47754	Parmeshwar Swarup Bhatnagar
47755	Pooran Singh
47756	Tilak Raj Arora
47757	Satyanarayan Gongopadhyay
47758	Arun Kumar Mazumder
47759	Shrawan Kumar Malhotra
47760	Jugal Kishore J. Mathur
47761	Mamchand Banarsidass Bhardwaj
47762	Husaini Bohra
47763	Vijalapur Ananthaiyer Swamynatha Iyer
47764	Suresh Chandra Sanadhya
47765	Hardev Singh Virdi
47766	Ramesh Chandra Calla
47767	Mohan Lal
47768	Raj Kumar Gora
47769	Chandra Prakash Jain
47770	Ganapati Mondal
47771	Uttam Chand Rajput
47772	Surendra Mohan Vatsa
47773	Swaminath Puspak
47774	Ugam Ram Sharma
47775	Bheru Lal Tailor
47776	Lakshmanan Krishnamurthy
47777	Madan Lal Jaggi
47778	Ramavatar Mishra
47779	Dinesh Kumar Ajmera
47780	Harish Chand Jain
47781	Anokh Singh
47782	Harilall Lalchand Balchandani

STUDENTS—(*contd.*)

No.	Name
47783	Munna Lal Goel
47784	Nand Lal Modi
47785	Ramesh Chandra Tela
47786	Ishwar Chand Chawla
47787	Jyotindra Dayanand Acharya
47788	Hirendra Kishore Sharma
47789	Kunnath Sathyanarayanan
47790	Girdhar Gopal Saxena
47791	Rama Kishan Purohit
47792	Labu Ram
47793	Satya Pal Bawa
47794	Surendra Kumar Papriwal
47795	Prem Kumar Joshi
47796	Dave Dutt Chaturvedi
47797	Vinay Pratap Sharma
47798	Gyanendra Kumar Jha
47799	S. K. Venkataraman
47800	Ananthashenoi Sarvothama Shenoi
47801	Pankaj Pareek
47802	Lal Chand Verma
47803	Narendra Kumar Agarwal
47804	Chandan Mal Deoli
47805	Rajeshwar Prasad Gupta
47806	Deep Chand
47807	Suresh Chandra Kalla
47808	Sita Ram Gupta
47809	Balbir Singh Chilana
47810	Ram Ratan Kanoongo
47811	Narottam Lal Bhasin
47812	Ram Lal Sardana
47813	Rameshwarlal Beharilal Mathur
47814	Chandra Shekhar Sanadhya
47815	Narinderjit Singh Ghai
47816	Sukhbir Singh Maini
47817	Dinesh Kumar Saxena
47818	Anil Kumar Dewan
47819	Swarn Lal Sehgal
47820	Alu Jhamatmal Datwani
47821	Shree Mandal
47822	K. Abdul Rahman
47823	Jai Prakash Gupta
47824	Nand Kishore Sharma
47825	Kalika Prasad Sharma
47826	Teekam Singh
47827	Chandra Shekhar Kalla
47828	Harish Chandra Gupta
47829	Bhupinder Swaroop Bhatnagar
47830	Nand Lal Purohit
47831	Prasan Kumar Hathi
47832	Roop Singh
47833	Shadi Lal
47834	Sharad Kumar Sharma
47835	Subhash Chandra Jain
47836	Amrit Lal Shreemali
47837	Kharaiti Ram Awasthi
47838	Dattatray Krishnaji Nisal
47839	Jagdish Narain Mathur
47840	Suresh Chandra Murlilal Mathur
47841	Prem Singh
47842	R. Ramanujam
47843	Giri Raj Gupta
47844	Tarit Kumar Chakravorty
47845	Devki Nandan Pant
47846	Heera Lal Gour
47847	Ramesh Chandra Jain
47848	Narasimhachari Badrinarayanan
47849	Brij Nandan Singh Chauhan
47850	Baidehi Kumar Chaudhuri
47851	Shyamsunder Bheemsenrao Tavag
47852	Manyam Gopal
47853	Asok Kumar Biswas
47854	Suresh Chandra Gupta
47855	Vasant Balakrishna Sideed
47856	Hari Singh Bist
47857	C. Radhakrishnan
47858	Parminder Singh
47859	Sibnath Das
47860	Nikhil Chandra De
47861	Rattan Lal Dewan
47862	Vaidyanatha Krishnamurti Balasubramanian
47863	Srinivasa V. Ramanan
47864	Kashinath Ghosh
47865	Vasant Damodar Phatak
47866	Krishnamachari Parthasarathy
47867	Philar Raghunandan Rao
47868	Vinod Sethi
47869	Goutham Kishore Chakraborty
47870	Dharam Bir Sud
47872	Chitta Ranjan Pal

STUDENTS—(*contd.*)

No.	Name
47873	Kookkal Achuthan Kotty
47874	Kanwal Krishan Pruthi
47875	S. Ramaswami
47876	Rangaratnam Ramamurthy
47877	Bachan Lal Kalra
47878	Chaman Lal Jain
47879	Ram Niwas Gupta
47880	Satish Chandra
47881	Jitendra Mohan Varma
47882	Balwant Kumar Bhaneja
47883	Pitu Dadlani
47884	Malempati Krishna Mohan
47885	Rajinder Singh
47886	Sanka Rama Rao
47887	Qazi Saeedul Hasan
47888	Periaswamypillai Muruganandham
47889	Chandraiah Devendra
47890	A. V. Achuthan
47891	Vikram Pratap
47892	Krishnaswamy Govindarajan
47893	Devarayappa Hanamappa Karadi
47894	Mahabir Parshad Bansal
47895	M. Veerappan
47896	Subhash Chander Handa
47897	Sukumar Gupta
47898	Anil Kumar Mitra
47899	Ram Kishore Gupta
47900	Umapathy Loganathan
47901	K. Venkatachari
47902	Krishnamoorti Sastrigal Tyagarajan
47903	Surender Kumar Sakhuja
47904	Rajan Sundaramurthy
47905	Subhash Chander Sabherwal
47906	S. Raja Aiyar
47907	Sushil Kumar
47908	Virinder Mohan Uppal
47909	Sunder Sham
47910	Mangalam Kumaraswamy Muthuvelu
47911	Sibnath Barman
47912	Abul Hashim
47913	Umesh Prasad Sharma
47914	Ravinder Nath Sood
47915	N. P. Ramaswamy
47916	Ranadeb Mukhopadhyay
47917	Hariraja Lakshminarayana Udupa
47918	A. K. Duraivelu
47919	R. Venkatesan
47920	Thandarayapuram Ramasamy Pachamuthu
47921	Koshy Puthenveetil Zachariah
47922	Amalesh Ghosh
47923	Sanjib Kumar Majumdar
47924	Ismailshalabbai Kaji Sheik Sikkandar
47925	Ganesh Datta Kaushik
47926	S. Mani
47927	Kanti Parshad Agrawal
47928	Nitan Kumar Pandey
47929	Janakiramaiyer Balasubramanian
47930	Mayuram Krishnamurthiiyer Balasubramanian
47931	Lakshmi Narayan Ghosh
47932	Santanu Bhattacharya
47933	Durgadas Bandyopadhyay
47934	Sushanta Kumar Roy
47935	Mattur Subramaniam Krishnamoorthy
47936	Nafis Ahmad
47937	Thota Nagabushanam Sreenivasan
47938	Purisai Thirunarayana Kannan
47939	Vinod Kumar Mittal
47940	George Kurien
47941	Parkash Chander Bajaj
47942	P. Srirengan
47943	Om Prakash Sharma
47944	Basheshar Lal Singhal
47945	Darshan Kumar Jolly
47946	Chennakesavalu Sundaresulu
47947	Nirmalendu Kumar Pal
47948	Biswa Mohan Majumdar
47949	Ashutosh Nag
47950	Tapas Kumar Talukder
47951	Krithivasan Narendran
47952	Salil Kumar Bose
47953	Ranjit Singh
47954	Tarit Baran Datta
47955	Asok Kumar Ghosh
47956	Lakhbir Singh Cheema
47957	Gulsheer Khan
47958	Somesan Balasubramanian
47959	Krishnamurthidikshidar Balasubramanian

STUDENTS—(*contd.*)

No.	Name
47960	Sharwan Kumar
47961	Pandurang Tanaji Pawar
47962	Chippigara Viswanath
47963	Nanjundaiah Radhakrishna
47964	Govindacharya P. Jahagirdar
47965	Swarnapuri Pandadu Premachandra Rao
47966	Bhalchandra Kashinath Umbarkar
47967	Virinder Kumar Sehgal
47968	Brij Mohan Gupta
47969	Kantilal Visanji Shah
47970	Sukan Pal Singh Verma
47971	Jayanthi Seetharam Setty
47972	K. Visvanathan
47973	Pradip Kumar Chakrabarti
47974	Kanneganti Venkateswara Rao
47975	Hazari Lal
47976	Inder Raj Ahuja
47977	Ramaswamiiyer Ganesan
47978	G. Navaneethakrishnan
47979	Shrikant Dattatray Kavade
47980	Amagond Shivagond Biradar
47981	Krishnarao Sreedhara
47982	Benakappa Husenappa Mellayyanawar
47983	Karnamadakala Seshachar Ranganath
47984	Kodakal Ganaraja Bhat
47985	Madapusi Srinivasan Sundaram
47986	C. G. Rama Murthy
47987	Subramanian Venkatesan
47988	M. Vijayaraghavan
47989	Hari Prakash Sharma
47990	Tarun Chandra Bagchi
47992	Ashoka Jaykrishna Chury
47993	Ramasamy Muthunarayan
47994	Surulivel Rajaram
47995	S. Rangaswamy
47996	Krishan Kumar Singhal
47997	Chandrasekharapuram Narayanaiyer Thiagarajan
47998	Venkataraman Ramachandran
47999	H. K. Sundareshan
48000	Krishnarao Sudarshana Rao
48001	Om Parkash
48002	Mysore Ramaiah Jagadish
48003	M. Ramaswami
48004	Rajinder Paul Kohli
48005	Ekanatha Ganapathisubramanian
48006	Gundabathula Bhaskara Rao
48007	Kumbakonam Balakrishnan Srinivasan
48008	Jagdish Singh
48009	Uchil Prabhakar
48010	Vishwa Nath
48011	Ghasita Singh Dhiman
48012	Vishnampet Subramania Sivaraman
48013	Srinivasa Damodaran
48014	Madapura Srikantiah Venkatasubbiah
48015	Shyam Kumar Jolly
48016	Baldev Singh Sohi
48017	R. A. Srinivasan
48018	Dinkar Damodar Chhatre
48019	Kishin Lachmandas Panjwani
48020	Vijay Kumar Sood
48021	Narayanampotti Sreeman Namputhiri
48022	Dharminder Singh
48023	Veeraraghavan Narasimhan
48024	Chandra Prakash Agarwal
48025	Jagdish Chandra Parija
48026	Jagdish Chandra Gandhi
48027	Sheikh Amanullah
48028	Himansubhusan Ghosh
48029	Paikattu Cherian Babu
48030	Mohan Lal Sharma
48031	Hari Shankerlall Gupta
48032	Kasiviswanathan Mahadevan
48033	Doongar Singh
48034	Satya Prakash Katyal
48035	Ambesh Sarvottam Kudchodker
48036	Vasudeo Narayan Rajguru
48037	Ravindran Madhavan
48038	Nenmeli Srinivasan Jagannathan
48039	Prem Singh
48040	P. Srirengan
48041	Varghese Thomas Kutty
48042	Musty Umamaheswara Rao
48043	Malikkaltharathu Gopalapillai Balachandran
48044	Koshy Kaleecal Peter
48045	Syedibrahim Kader Mohiadeen
48046	Chavali Viswanadham
48047	T. Santhanam
48048	P. Kanakasabapathy
48049	Manangam Balasundaram Pandurangam

STUDENTS—(*contd.*)

No.	Name
48050	V. Gopinathan Nair
48051	T. Swaminathan Balakrishnan
48052	Ranendra Nath Mitra
48053	Jnanendra Nath Ghosh
48054	Shakti Pada Datta
48055	Debabrata Chakrabarti
48056	Padala Adinarayana
48057	Saroj Kumar Sarkar
48058	Dole Govinda Chattoraj
48059	Santi Kumar Begani
48060	Devendra Kumar Sinha
48061	Shivram Krishnan Ayyer
48062	Shanti Sagar Bhalla
48063	Tusar Kanti Ghosh
48064	Radha Krishna Ram
48065	Ramesh Chandra Mohtani
48066	Hasmukh Harilal Doshi
48067	Senigarapu Laxminarayana
48068	Prabhakar Harihar Kulkarni
48069	Kamla Prasad
48070	Srivella Malakondaiah
48071	Durgeswar Kalita
48072	Pramod Anant Vartak
48073	Raj Singh Nirman
48074	Ajoy Kumar Goswami
48075	Sudesh Gogia
48076	Mohd. Abdul Wajid
48077	Darshan Kumar
48078	Keshav Lall Guliani
48079	Mohan Ram Chowdhary
48080	Nagendra Pandey
48081	Virendra Kumar
48082	Yougendra Pal Garg
48083	Sewa Ram
48084	Ramasubbaiyer Viswanathan
48085	Shyam Sunder Kheterpal
48086	Jagabandhu Lahiri
48087	Sundhir Kumar Das
48088	Tarun Kumar Barman
48089	Pares Nath Laha
48090	Jatindra Mohan Chatterjee
48091	Subha Brata Roy
48092	Priyatosh Choudhury
48093	Brij Bhushan Bansal
48094	Sisir Kumar Haldar
48095	Gitindra Nath Ray
48096	Kul Bhushan Kashyap
48097	Indrajit Girdharilal Khatri
48098	Arup Kumar Mukhopadhyay
48099	Vas Dev Arora
48100	Rajendrakumar Bhimjibhai Patel
48101	Bhabes Kumar Saha
48102	Bimal Chandra Bhaduri
48103	Krishen Lal Koul
48104	Gopal Prasad
48105	Mukund Narayan Apte
48106	Pratap Kumar Basu
48107	Harish Chandra Bali
48108	Basanti Lal Surana
48109	Kanhaiyalal Sharma
48110	Purushottam Pathak
48111	Govind Narain Mathur
48112	Prem Behari Satsangi
48113	Ishwar Chand
48114	Vinod Prakash
48115	Devi Das Mathur
48116	Balbir Singh Khosla
48117	Ramnik Lal Mehta
48118	Surinder Kumar
48119	Mohanlal Naithani
48120	Durga Dass Ahuja
48121	Santokh Singh
48122	Ashim Chandra Datt
48123	Sarda Charan Saxena
48124	Suneel Kumar Bhandari
48125	Krishan Swaroop Sharma
48126	Prabhu Dan
48127	Nripendranath Mitra
48128	Ramesh Chand Agrawal
48129	Dewarka Nath Kaul
48130	M. K. Chandrasekharan
48131	Raghubir Sharan
48132	Arun Vishnupant Thombre
48133	Shree Krishan Chandra Srivastava
48134	Nanasaheb Bhau Patil
48135	Md. Nayeemuddin Ansari
48136	Abinash Chandra Sinha
48137	Nitya Nand Prasad
48138	Ravindra Malik
48139	Om Prakash

STUDENTS—(*contd.*)

No.	Name	No.	Name
48140	Devendra Kumar Garg	48185	Gurmail Singh Sandhu
48141	Chandeshwar Prasad Singh	48186	Kiran Singh
48142	Gauri Shankar Mishra	48187	Jaydeb Karmakar
48143	Kuldip Chand	48188	Suresh Chand Goel
48144	Subhash Ranjan Gun	48189	Pranab Kumar Ray
48145	Atiquezzaman	48190	Vijay Kumar Grover
48146	Nani Gopal Das	48191	Surinder Kumar Khanna
48147	Sourendra Nath Roy Choudhury	48192	Radhey Shyam Sharma
48148	Dilip Kumar Banerjee	48193	Roshan Hatimbhoy Bambot
48149	Umashankar Prasad Sinha	48194	Sethuraman Subramanian
48150	Ravindra Laximona Poi	48195	Ramachandra Sundaresan
48151	Prabhu Nath Singh	48196	B. Rama Rao
48152	Arun Laxmanprasad Jetly	48197	Y. Rajagopal
48153	Suresh Chandra Somani	48198	Jawahar Lal
48154	Kuldip Singh Samyal	48199	Sagar Chand Jain
48155	Samarendra Nath Mukherjee	48200	Abdullah Rajabali Masani
48156	Binod Bihari Jaiswal	48201	Manipur Panduranga Kini
48157	Girish Nandan Sahay	48202	Atam Prakash Chhabra
48158	Lolla Srirama Moorty	48203	Narayan Iyengar
48159	Subramania Varadarajan	48204	Krishanchand Khushiram Dutt
48160	Binay Kumar Bajari	48205	Satimoy Nath
48161	Pasupulety Babu Rao	48206	Hirendra Kumar Das Gupta
48162	Moti Lal Kak	48207	Jitendra Nath Sarkar
48163	S. Thiruvengadathan	48208	Lalit Mohan Sarma
48164	Amrit Nath Jha	48209	Pranab Kumar Mukhopadhyay
48165	Paras Ram	48210	Charanjit Singh Sachdev
48166	Dhirendra Kumar Srivastava	48211	Des Raj Kalra
48167	Suryyabikas Chattopadhyay	48212	Suraj Kumar
48168	Amaresh Chandra Bhattacharya	48213	Hari Pal Singh
48169	Dilip Kumar Mukherjee	48214	Rati Ram
48170	Natthu	48215	Jagjit Singh Bhasin
48171	Kashi Nath Kaul	48216	Bimal Kumar Khullar
48172	Ranajit Kumar Lodh	48217	Surinder Singh
48173	Shaik Sultan	48218	R. Doraiswami
48174	Om Parkash Pandoh	48219	Krishan Chander Manchanda
48175	Nara Narayan Sengupta	48220	R. Ranganathan
48176	Autar Kishen Bhan	48221	Jagdish Chander Grover
48177	Arup Kumar Ganguly	48222	Raj Kumar Bhirani
48178	Satish Chander	48223	Krishan Lal Rawal
48179	Billa Madhava Reddy	48224	Sarab Krishan Sahi
48180	Radha Kishen Sharma	48225	Shiv Charan Dogra
48181	Pran Nath Sahgal	48226	Kishan Chand
48182	Raghbir Singh	48227	Inder Pal Kumar
48183	Balwant Gopalrao Dixit	48228	Om Prakash
48184	Sandip Kumar Sil	48229	Nagina Prasad Singh

STUDENTS—(*contd.*)

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48231	Syed Sirajuddin Khadari
48232	Polina Gopalakrishna
48233	Bishambher Dayal Dogra
48234	Vijay Singh
48235	Bharat Singh Saini
48236	Girish Babu Saxena
48237	R. B. Narasimhan
48238	Balachandra Gopalarathnam
48239	V. Varada Ekambaram
48240	Nagelia Venkata Suryanarayana
48241	Banshidhar Singh
48242	Raghupathi
48243	Ephrain Moraise
48244	Lokanath Chowdhury
48245	M. Purushothaman
48246	C. K. Eapen
48247	T. S. Govindaraghavan
48248	Krishnaswamy Srinivasan
48249	S. Thamizharasan
48250	B. R. Sekhar
48251	U. A. Md. Ghouse
48252	G. Vaitheeswaran
48253	C. Ramachandran
48254	Puliyankulangarai Sethumadhavan
48255	N. A. Nazareth Walter
48256	Indra Poovaiah
48257	Balakrishna Venugopal
48258	Katragadha Muralikrishna Mohana Rao
48259	P. J. George
48260	K. N. Velayutham
48261	Arokia Silmai Muthu
48262	Krishnamachari Rangaswami Santhanam
48263	Balvir Singh
48264	Sant Parkash
48265	Kuldeep Kumar Bassi
48266	Gurnam Singh
48267	Kalloorkizhakkathil Ommen Varghese
48268	Usoof Sheriff
48269	S. P. Ganesan
48270	Vijaykumar Jagannath Junagade
48271	N. Subramanian
48272	Mohini Mohan Ghosh
48273	Somanath Veerabhadrappa Pattanashetti
48274	Sudarshan Kumar Dhurgia
48275	Ram Sharan Gupta
48276	Jeet Raj Taluja
48277	Prakash Kumar Tandan
48278	Birendra Kumar Chakravartty
48279	Thilagar Jeyasingh
48280	Sambandam Annamalai
48281	Mukund Dattatray Chaudhari
48282	Divakar Yeshwant Patti
48283	Upendra Chandra Rout
48284	Bhamidipaty Lakshmi Narasimha Rao
48285	Raj Singh
48286	Niranjan Singh Tyagi
48287	Byreddi Balanarayana Reddi
48288	Surendra Bahadur Nigam
48289	Sudhir Kumar Das
48290	Deb Kumar Sinha
48291	Muhammad Waseem Farshori
48292	V. Ramani

CORRIGENDA

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Civil Engineering Division Part : page 805, please read page-heading as 'DISCUSSION ON EXPANSIVE SUB-CRITICAL FLOW IN OPEN CHANNEL TRANSITIONS.'

Mechanical Engineering Division Part : page 247, please read the last line as '*This paper was received on June 28, 1963*'.

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